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The Solution of Engineering Problems

By Frank L. Watson

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ALTHOUGH every real engineer is a philosopher, his daily work is so absorbing that his philosophy is not often committed to writing. Perhaps this is due to the mass of technical literature with which he must keep in touch. To be a really complete engineer, assuming for the moment that perfection exists, it would be necessary to know everything, and the consciousness of this keeps him humble, just as the success with which some other professions can pretend to know everything, produces the opposite effect.

Life is short, engineering art is long. Just as economy of labor is promoted by the steady flow of material from process to process, and by the ordered meeting of components until a finished car propels itself out of the factory, so may economy of brain and nerve be promoted by the systematic flow of ideas from stage to stage, and their ordered combination, until there emerges a design whose fitness for its task is as certain as anything human can be.

> The proper time for engineering enterprise is precisely the time of a general slump. Engineering work takes time to carry out. It can be done at its lowest cost during a slump and the new work is then ready for use when the general demand rises, that is to say, when it is most wanted

In those remarkable lectures given by Marshal Foch when a Professor at the École Supérieure de la Guerre, published under the title "Des principles de la Guerre," the bases of the decisions necessary to success in war are set forth so clearly and so certainly as to have proved applicable to the new conditions of the Great War without any essential modification. But although, unlike war, engineering is always with us, its basic principles, whilst well understood and observed by many individuals, have not been classified for general use.

The engineer's life is spent in the solution of problems; and a great deal of it is wasted on problems that have been solved already, or on problems that are not worth solving, or on taking a needlessly long road to a solution.

There are three sides to every engineering problem:

1. The objective;
2. The means available;
3. The possible solutions.

The waste caused by omitting to commence with a real grasp of the objective, or by jumping to a solution without full consideration of the means available, is incalculable.

The objective may assume one of several general forms. For instance, we may have to deal with a problem that has already found a solution, recognized as imperfect or temporary, and for which a more economical substitute is desired.

One example of this type is the propulsion of ships, a very ancient problem, which, in every period of history, has found a solution conformable to the means available.

The oar, propelled by human effort, was suitable to a period when timber was the only material and slave labor was plentiful and cheap. The sail became practicable when woven fabrics of large size could be obtained. The paddle wheel became practicable with the advent of the steam engine. High pressures and the expansive use of steam, and higher speeds, followed on the introduction of machine tools capable of accurate boring and turning, and rendered possible the use of the screw propeller. The invention of the steam turbine could not have been made practical without the use of new methods and materials.

The internal combustion engine offers a further solution, which has not reached its final form, and whose requirements are leading to fresh research and invention in the line of materials that will retain their strength at high temperatures.

In each period the objective of this particular prob-

lem of ship propulsion has been simple and obvious. In each period it was a change in the means available that rendered the next solution possible, and the preceding one was then rendered uneconomic. And in every period history shows that ingenious men have gone beyond the means available, and have failed, and often been ruined, by anticipating solutions that were successful at a later period, but impracticable at the date of their first conception.

There is a second type of objective, which lends itself to a complete solution, taking rank thenceforth as one of the permanent elements of engineering art.

The following simple examples, which could be multiplied indefinitely, will serve as illustrations:

(a) The problem of constructing a bridge with materials suitable only for compressive stresses, the solution being the arch, which, having regard to its antiquity, is one of the noblest products of the human mind.

(b) All the primary mechanical problems, such as the conversion of rotary to linear motion and the converse.

(c) The production of threads of unlimited length from fibres of limited length, solved by the very ancient invention of spinning.

(d) The production of fabrics from threads, which has found two solutions, both very ancient, in the invention of weaving by passing a series of threads transversely through the alternate crossings of another series, and knitting, by passing a succession of loops each through the last preceding loop in a thread.

New Methods Applied to Old Processes

Modern textile industry is chiefly built up on the reproduction by mechanical power of the ancient hand methods mentioned under (c) and (d), which was the characteristic of the eighteenth century, just as that of the nineteenth century was the development of mechanical transportation; the essential feature in each case being the application of new means, by inventors who grasped their significance, to very old processes. Hundreds of examples of this kind of problem will occur to the mind, success in every solution coming to those who studied and utilized the means available, whilst failures innumerable strewed the path of those who endeavored to go beyond those means, either from ignorance or from optimism.

A third type of problem is that of providing some entirely new utility, for which no previous solution exists. A comparatively recent example is the transmission of energy without transference of matter, whose present solution is electrical.

The objective, then, is usually a conception which can be grasped by any competent mind, although even here it is of the first importance to know the history of the problem, and to understand the reasons of past failures.

It is in connection with the second element, that is to say the means available, that the specialized training of the engineer comes into the picture, and it is just because the objective is easy to understand, and the means available highly technical and often very difficult to fully appreciate, that the financier is so impatient of engineering methods and falls so frequently a prey to the plausible quack.

It is the purpose of all engineering training to make a man acquainted with the materials and tools at his disposal, and so to develop his mental processes and his critical faculties that throughout his life this knowledge shall continually grow, and that, whatever branch of this art shall claim his attention, he will not fail either by omitting to consider means that are available, or by committing himself to means that are not available.

Both these errors were committed by the engineer officer, in one of Roberts' campaigns, who was called on to bridge a stream in the jungle. He retired to his tent and after hours of calculation produced a plan showing the necessary beams, struts and flooring, all as laid down in the manual of field engineering. In the meantime a native non-commissioned officer had taken a party into the jungle, cut a sufficiency of bamboo poles and green withes, and constructed a bridge over which the last troops were passing when the engineer emerged with his plans.

Cases are not unknown in which a specialist who has made a reputation by the judicious use of materials available in one locality, will design and specify similar works universally, thus involving his employers in needless expense and neglecting local materials whose use would be a real economy, but would involve new designs.

When an employer places an engineering problem in the hands of a man of skill, the quality which he has a right to expect is precisely that knowledge of the means available which is implied in the engineer's qualifications. Sound judgment, originality, genius, cannot be guaranteed; the employer must take his own risk when he exercises his judgment in selecting his engineer; but the implication of knowledge of the art is essential, and is the best justification of the demand for a statutory qualification of the engineer similar to the statutory qualification of the doctor or the lawyer.

If there is more than one means available, there will be more than one solution. All solutions must be considered, although some may be promptly rejected, and the number thus narrowed down. The decision between several solutions, any one of which would be effective, must rest upon purely economic grounds.

Engineering Works Must Be Immediately Valuable

If several solutions appear equally complete and satisfactory, the least costly must be chosen; if there are degrees in regard to the completeness of the solution, or in regard to the cost of operation and upkeep, these degrees must be balanced against cost of construction. In making such a balance, the utmost candor and the resolute suppression of mental bias are called for; but if the methodical process here advocated has been followed, the final conclusion will be inevitable, and can be adopted and acted upon without the slightest doubt or hesitation.

The only condition upon which the world will support the engineer, is that his work has an immediate and realizable value. In other words, the engineer can only expect his fellow creatures to provide him with the necessities and comforts of life, in so far as his work goes to make such necessities and comforts more plentiful or more accessible to others; that is to say, to reduce the cost of production or of distribution; and the very reality of his services seems to place him at an economic disadvantage as compared with the parasitic occupations.

The wealth of the modern world consists principally of engineering works of either permanent or temporary utility, which form the framework of civilization, and whose destruction would involve the death by famine of most of the population of Europe. From this fact

arises the constant danger of a disaster to civilization resulting from the success of one of the recurrent conspiracies to put pressure on the community by paralyzing its mechanism; a danger that appears to grow with the increasing interdependences of mechanical services, and the concentration of the forces that control them. It seems necessary that this vast problem, due to mechanical progress, should find a mechanical rather than a political solution.

The essence of every engineering problem, with the proper solution for every separate time and place, is therefore economic in its nature, and no engineering work can be regarded as well done unless this factor is fully recognized.

From the fact that engineering work involves the fixation, or what one may call the *crystallization* of capital, it follows that the engineer must look to those who control capital for his employment. For this reason, in times of difficulty, the engineer suffers first and worst; those in control of capital in bad times wish to keep it fluid, or, as they say, to "husband their resources," and so its crystallization in engineering work is stopped.

The Time to Begin

Now the proper time for engineering enterprise is precisely the time of a general slump. Engineering work takes time to carry out; it can be done at its lowest cost during a slump; and the new work is then ready for use when the general demand rises, that is to say, when it is most wanted.

As things are, engineering enterprises are freely undertaken during a boom in general trade, when costs are high; they are frequently only ready for use when trade is already flagging, and their economic value then rapidly drops below their cost. Then follows the painful process of writing down capital values, in the course of which the credit of great businesses is shaken to its foundations.

One is led to the conclusion that the organization of capital has fallen far behind the general progress of the mechanical arts; it is crystallized into permanent works just when it is least advantageous to take that course, and reserved just when it would be most advantageous to invest it.

Where the control of capital is in the hands of men who combine high technical acquirements with wide vision, or where such men can gain and keep the confidence of capitalists, a very different policy leads to successful results.

We have reached a stage in which the advancement in quality of material and in mechanical processes has become continuous, and when no improvement need be long delayed for want of tools and methods. The vital condition of engineering progress today, is that capital should be made available in the necessary quantity and at the most advantageous time.

If this is to be secured, the loss of capital due to its investment in the wrong objects or at the wrong time must be stopped, and it must be diverted to the right objects at the right time.

The connection of this subject with engineering is so vital that it may be fitly described as the greatest and most urgent of problems of the day.

Corners of jigs and fixtures should be rounded as a safeguard to the operator against cuts and scratches.

Seen and Heard

By John R. Godfrey

Women in the shop—Competition and sales

IN VIEW of the large numbers of women who went to work in machine shops during the war, it is a bit surprising to find that so few stuck to the work. There must have been many whose tastes leaned more toward mechanical things than toward washing dishes and cooking for a grouchy male. For there seems to be no more reason for every woman liking, or being fitted for housework, than for every man to dote on being a bookkeeper or a piano-tuner.

It is probably because most machine shops now have very few women that they were very noticeable in two shops I visited the other day. Both shops had women enough to remind me of war times, and in one there were still a goodly number in the tool room. The foreman was quite enthusiastic over their work and showed me how well they handled a lot of tool work.

When the foreman had gone the G.M. told me how hard the aforesaid foreman had fought putting women into the tool room in the beginning. The foreman was noted for having a choice vocabulary of cusswords and perhaps feared that his style might be cramped. But whether he found that some of the girls could hold their own in a cussing match, or their work overcame his prejudices, he is now a stanch advocate of women in the tool room and would fight for them as hard as he did against them.

* * * *

Competition is a funny bird. According to the old adage it's the life of trade—but many find it the death of business. It sometimes not only kills the loser but puts such a crimp in the winner that he wishes the other fellow had secured the contract. Generally speaking, competition lowers the cost of manufacturing and increases the cost of selling. It frequently gets a lower price for the buyer, and just as frequently perhaps, trims the stockholders' dividends.

From the shop man's point of view, all the economies have to come out of the shop. The sales department is always demanding lower costs to meet competitors' prices, in spite of the fact that on many products the direct labor cost is already so low as to have very little effect on the purchaser. In certain well-known products, the total sales cost is from five to seven times the cost of direct labor.

Just as a suggestion to the sales department, it might try to devise some plan whereby the customer who is hard to sell, and boasts of it, pays more than the man who is reasonable in his demands for tests and service.

As a rule the opposite holds true today. The man who kicks the most gets the best service. If he demands demonstrations he gets 'em. If he kicks he gets the best rooms in the hotel or in a restaurant. He gets more attention and service than the man who tries to be reasonable and civil.

If the sales department can devise some way of making it pay a customer to cause as little trouble and expense as possible, it will be taking a step toward reducing sales costs. It is frequently more profitable to lose a sale than to make it, even though it does go against the grain of the sales department.

Experience—Whose Is It?

By Entropy

JIM wanted to get a new foreman for his pattern shop. In fact he had to, because the old one died. No one in the shop looked like the right kind of material, and while Jim was undoubtedly to blame for the condition, there is not much use crying over spilt milk. Jim had to have a foreman, he had to have one soon, and he wanted a good one.

Between us we sifted all the names of men who applied, and found next to nothing. Then we went over all the men who were, or might be, foremen in other shops, and we finally picked out a man who looked mighty good despite the fact that he had red hair and a temper that fitted his looks. But anyway Jim doesn't run a big enough pattern department to expect all the virtues in one man. Besides, the man that this chap, call him Johnson, worked for had told me only a little while ago that he meant to make a change because Johnson was too redheaded. There was our man all available, the next job was to get him lined up without swelling his head.

I got hold of him one evening, found out that he had thought a lot about getting another job, so I tipped him off that Jim had a vacancy. Johnson, of course, went around to see Jim and they struck a bargain. Jim told him that he would have to give a notice and work it out, because he wanted Johnson's employer to feel all right about it. Just how Johnson went at it to get out "right" I do not know, but Jim showed me a letter from Johnson's firm, signed by the general manager, that ought to have been written on asbestos paper. You could smell smoke as soon as you opened the envelope. It seems that Jim is the worst pirate, the only man that is out of jail that ought to have been shot, and a lot of other things that are not printable. This employer, according to the general manager, had taken Johnson when he was a worthless mechanic, on his uppers, and out of pure kindness of heart had given him a job, taught him everything he know, paid him more than he was worth, and made him what he was. In fact, the g. m. almost claimed a proprietary interest in Johnson, such that if Jim hired him he would be as much a thief as if he had put his hand in the other man's pocket.

Jim was nonplussed. It seems that Johnson's story was to the effect that he had gone to work in that shop when no one else would take the job, he had found the pattern shop all run down at the heel, no system, everybody doing what they pleased, and for the sake of helping the owner he had taken small pay, worked overtime for nothing night after night, and he had finally put the thing on its feet. He believed that he was entitled to more pay, and not getting it he proposed to get out and work for a white man, if there was any such.

Jim just naturally got disgusted with both of them and hired another man. Then Johnson got the sack, and that is as far as I know the story; but what bothers me is how anyone is to know who owns acquired skill, ability and craftsmanship.

Every live man that works in a shop learns something. Every live man with any experience brings some ideas to each shop he works in. Some shops deliberately teach trades, and if the apprentice leaves before he has developed into a useful man, they think nothing of it. But if a man works for several years in the shop, progresses rapidly, especially if the management has taken any interest in his progress, the shop comes to think that it has a degree of ownership in the man. There are, however, a great many men who do build up a firm by virtue of their ability to organize, or through the experience which they have brought with them. Their work has meant the difference between prosperity and bankruptcy, and their claims seem quite as valid as those of the management. Whose is this knowledge and experience? Does it belong to the shop or to the man; or if to both, how can it be apportioned?

Check the Catalog Translation

By A. J. Smith
Solihull, Warwickshire, England

A recent issue of "Commerce Reports" directed attention to the need for greater accuracy in translations dealing with technical products. The examples quoted, such as "wrenches for monkeys" (monkey wrenches) and "machines for cleaning brass" (brass washers) are sufficient to show the amusing side of some of the descriptions embodied in export literature.

It is not generally appreciated that the technical study of a language is a thing quite apart from its literary acquisition, and that it is much simpler. It is possible for an engineer with little beyond a high-school knowledge of French to have such a knowledge of the technical terms pertaining to his industry as would enable him to correct the inaccuracies of a professor of the language.

International competition makes it necessary that every manufacturer should have a knowledge of foreign equivalents for the terms in use in his industry, if costly and irritating mistakes are to be avoided. When one considers the shortcomings of the average technical translator and the defects of the ordinary dictionary, he is tempted to wonder whether after all there is not something to be said in the favor of using only his own language. The method has the advantage of being entirely clear to one of the parties, at least, whereas a badly bungled translation is comprehensible to neither.

It is seldom, for instance, also that a translator does not render the word cupola into French by the word "coupole," which resembles it in appearance, but means "dome.' It is only by turning to a dictionary that is amplified with detailed drawings that these matters become clear. In one export catalog the writer was for a long time puzzled to account for a certain item in the equipment of a cupola furnace, which in both the French and Spanish editions was referred to as the driving belt. Light was thrown on the subject only when it was discovered that in England the wind box of a cupola is called the "air belt," and the English translator did not know the goods he is describing.

A technical dictionary in several languages with illustrations will save its owner many times its first cost every year. Post-mortems on defunct foreign trade and "dead" customers will frequently reveal some series of expensive mistakes in translation that could be avoided by checking aaginst an illustrated dictionary. The experiences, however, are not without value if they are taken as showing that a study of foreign technical terms is both interesting and profitable.

No one system of standardization seems to fit all cases. But why penalize 80 or 90 per cent of manufacturing because a few require special sizes or fits?

Gear Teeth in Action

By Earle Buckingham
Associate Professor of Engineering Standards and Measurements
Massachusetts Institute of Technology

Lubrication of rolling mill gears—Frictional heat and its dissipation—Effect of critical speed upon gear performance—Reduction of gear problems to simple levers

FROM the viewpoint of lubrication, conditions in the rolling mill are different from those discussed heretofore. In fact, the lubrication of blooming mill gears, roll necks, and steam engine cylinders involves probably more difficulties than any other phase of industrial plant operation.

The pinions adjacent to the roll necks in the blooming mill are usually inclosed in an oil-tight casing, in which they are run in a bath of specially-prepared gear compound of high adhesive characteristics, having a viscosity of about 2,000 sec. Saybolt at 210 deg. F. On the other hand, in some installations these pinions may be covered with shields that are not oil-tight and are without bottoms. Therefore, bath lubrication is out of the question, and the lubricant used must be able to stick tenaciously to the pinions over the periods that intervene between its applications and must maintain a sufficiently protective film. A viscosity of about 5,000 sec. Saybolt at 210 deg. F. is necessary in order that the resultant lubricating film may be able to withstand the terrific pounding and hammering that occurs, especially when the mill is reversed.

Not only in the blooming mill, but on all other rolls except in the plate and sheet mills, it is found necessary to run water constantly over the rolls and roll necks, for the dual purpose of cooling the rolls and blowing off the scale that may be formed as the ingots, bars, or billets are broken down. Such conditions, coupled with the extreme heat constantly encountered, place a most exacting requirement upon both the roll-neck and gear lubricants. These lubricants must be compounded products, inasmuch as straight mineral lubricants will not withstand the continued washing action of hot water. The usual procedure is to compound the gear lubricant with definite percentages of certain substances that will give the final product the desired adhesive properties. Any rolling mill gearing, however, that does not come in contact with water can be lubricated with a straight mineral lubricant of a viscosity ranging from 2,000 to 5,000 sec. Saybolt, according to temperature conditions and the manner of lubrication. (Allen F. Brewer, The Texas Co., in *Lubrication*, July, 1924)

Frictional Heat

The frictional heat developed between the meshing teeth of gears spreads through the gears and shafts and into the bearings and gear case. Where the gears are not cooled by a circulating oil system, the whole of the heat developed must leave by radiation through the gear case into the atmosphere. The gears and their cases, therefore, assume a temperature higher than the surrounding room temperature, and the more the friction the greater will be the difference between the temperature of the gear unit and of the room. The difference is termed the frictional rise in temperature, or simply the frictional temperature, and forms a true guide as to the quality of oil in service and its method of application. Any reduction in the frictional temperature brought about by introducing another lubricant or changing its method of application will mean that this lubricant or method is better or more suitable for the conditions.

The frictional temperature remains practically constant for all room temperatures; that is, if the gear case temperature is 86 deg. F. and the room temperature is 70 deg. F., the frictional temperature is 16 deg. F. If the room temperature rises to 74 deg. it will be found that the gear case temperature will rise to 90 deg.; the friction developed is practically the same, and the gear case temperature must therefore be correspondingly higher in order to radiate the same amount of heat into the atmosphere.

Oil as a Coolant

When gears operate under conditions of high speed or pressure, the heat developed may become so great that it cannot be radiated from the surfaces of the casing with sufficient rapidity. Under such conditions it becomes desirable or necessary to introduce a circulation oiling system by means of which the flow of oil that is directed on the gears not only serves to lubricate, but also removes a large portion of the heat developed. This heat carried away with the oil can be radiated into the atmosphere from the oil tanks and pipes, or, if necessary, can be removed by an oil-cooling arrangement.

If a greater flow of oil is required for purposes of cooling than is necessary for lubrication alone, the additional oil should be directed on the sides of the gear blanks and not on the teeth of the gears. Excessive oil on the teeth will develop further heat because of its rapid expulsion from between the gear teeth at the meshing point. As noted before, a flow of oil on the sides of the gear blanks alone will usually provide sufficient lubrication for the teeth of high speed gears.

The temperature of the gear case is an indication of the temperature of the gears, but it should be realized that the actual temperature of the gears will be appreciably higher than that of the case. If the frictional temperature rise, as indicated by the temperature of the case or lubricating oil, is more than 50 deg. F., steps

The third article. The fourth will appear in an early issue.

should be taken either to improve the lubricating conditions or to introduce an oil circulating and cooling system.

Because of this frictional heat, high speed gears must be made with sufficient backlash so that the teeth will not bind when the gears are heated and expanded.

As the actual amount of frictional heat developed by a pair of gears depends upon so many variables, such as the condition of tooth surfaces, speed, pressure, and the lubricating medium, it is impossible to calculate in advance the exact temperature rise that will be present. The best that can be done is to make an approximation. Such an approximation has its value, however, as in many cases it should make it possible to determine whether or not an oil circulation system should be provided. We must first make two assumptions: first, the amount of heat of friction to be dissipated; and second, the rate of dissipation from the case. The amount of heat of friction will be based upon the power transmitted by the gears and their assumed efficiency.

Well-made spur gears—and only such should be considered—show very high efficiencies. For our present purpose, if we assume a loss of power due to friction of one per cent of the load transmitted by the teeth, the approximation should be higher, if anything, than the actual conditions. We will use 2.7 B.t.u. per hr. per sq. ft. of exposed surface of the gear case as the rate at which the heat is dissipated for a difference of 1 deg. F. between the temperature of the gear case and the room temperature. This will be equivalent to about 35 ft.-lb. per min. per sq. ft. of exposed surface. Thus when

Q = difference between temperature of gear case and room temperature in deg. F.

W = load transmitted by gear teeth in ft.-lb. per min.

A = area of exposed surface of gear case in sq. ft.

$$Q = \frac{W}{3{,}500A}$$

As an example, we will assume a reduction gear unit that transmits 100 hp. with a case the exposed surface of which has an area of 20 sq.ft. These figures give the following:

$W = 3{,}300{,}000$

$A = 20$

$$\text{and } Q = \frac{3{,}300{,}000}{3{,}500 \times 20} = 47 \text{ deg F.}$$

In this example it should not be necessary to provide an oil-cooling system. If the case were smaller, however, so that its exposed area was only 10 sq.ft., the value of Q would be doubled. If such a unit were to be used in continuous service, an oil-cooling system would probably be necessary. If it were to be used only for intermittent service, it might be possible to do without such an oil-cooling system.

*It is a well known fact that some high speed gears have proved successful while others have not, though made with the same care and by the same concern. Sometimes gears show pitting on the tooth surfaces that cannot be explained by fatigue or by the amount of load transmitted. Furthermore, some of these drives are noisy at their operating speed. These unsatisfactory conditions seem to exist at times despite the care and attention given to the design and accuracy of the gear teeth.

*Abstracted from *Mechanical Engineers' Pocket Book*—Kent.

We will therefore for the present take our attention from the gear teeth and direct it to the shafts and other rotating masses. It is possible that many failures may be due to excessive oscillations in the elastic system that comprises the whole unit.

The center of mass of a rotating body, such as a gear and its shaft, never lies in its mechanical center of rotation. Even if this mass is balanced perfectly, there is a deflection due to the weight of the rotating bodies as well as that caused by the tooth pressure of the gears. Thus with a horizontal shaft, and with the direction of the gear tooth pressure downwards, the center of mass will lie below the true axis of rotation.

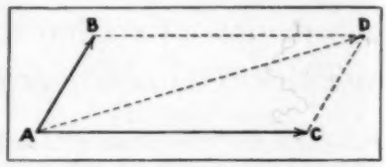


Fig. 1—Composition of forces

When rotation begins, the shaft remains bent downward, but as the speed increases, the centrifugal force increases until the speed reaches a point known as the critical speed, when the centrifugal force equals the force tending to bend the shaft downward, and excessive vibrations are set up. If the speed is increased above this critical speed, these vibrations disappear, and the revolving mass will rotate on an axis more nearly corresponding to its center of mass. Thus the critical speed occurs at the time when the axis of rotation shifts from the mechanical center of rotation to a point closer to the actual center of mass. This transition point is the first or lowest critical speed. There is, in addition, a series of secondary critical speeds of higher value but with diminishing amplitudes of vibration.

If there should be other vibrations present, the frequency of which correspond or harmonize with the vibrations at the critical speed, the vibrations at the critical speed will be increased in amplitude until, if not checked in some manner, failure will result.

Critical speeds exist in gear drives, and it is safe to say that those drives that run at a speed close to a

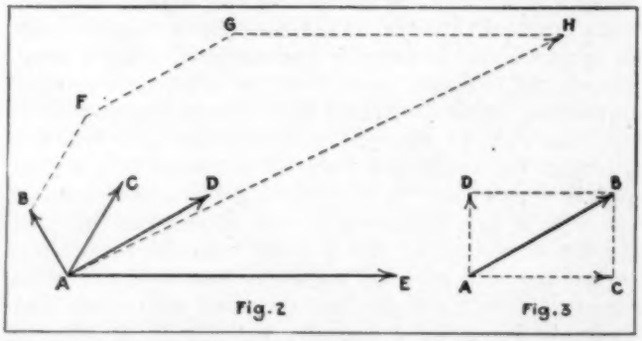


Fig. 2—Finding the resultant of four forces graphically
Fig. 3—Two components of a single force

critical speed will be unsatisfactory in operation. When gear defects, such as noise, pitting, or rapid destruction are primarily the result of running at such critical speeds, there is one sure remedy: that is to proportion the shafts and other rotating masses so that the resulting critical speed is changed to one a safe amount from the desired operating speed.

It is possible to figure critical speeds, but their calculation is a long and complicated process. Where important and expensive gear drives are involved, how-

ever, such calculations should be made in spite of the large amount of work involved. The subject of critical speeds is such an extensive one in itself that no attempt will be made to treat it further here, except to say that a rough approximation often used is given by the following:

$$\text{Critical speed in r.p.m.} = \frac{188}{\sqrt{y}}$$

where y = maximum shaft deflection in inches.

Some gear drives may run at speeds above their first critical speed. In starting, these should pass quickly through these speeds so that extreme vibrations will not be built up. The running speeds of gears should be at least thirty per cent above or below the critical speed. If the critical speed should figure out only slightly above the running speed, the shaft should be made larger and stiffer, thus raising the critical speed.

Gear Tooth Loads

It is obvious that the first step towards proportioning the gear teeth is to determine the loads that these teeth must carry. These loads are dependent upon the nature and amount of work that must be performed. The analysis of gear tooth loads involves many interesting problems in the resolution of forces into their components, and also the composition of forces to determine their resultant.

Mechanics treats of the action of forces and their effect. A force is sometimes defined as any cause that tends to alter a body's state of rest or of uniform motion in a straight line. A force is measured by the masses set in motion, and by the velocities imparted to them in a unit of time. The engineer's unit of force is the weight of one pound. In addition to force, there are two other fundamental quantities in mechanics that are used in combination to express various conditions. These quantities are distance, measured in feet or inches, and time, measured in hours, minutes, or seconds.

The term force is limited to the case in which some movement of masses is produced. If a pressure or pull is exerted upon a body not free to move, such an inactive pressure or pull is called a stress. A stress may be numerically specified either as a total stress or as a stress per unit of area. The total stresses may be measured as equal to the forces that produce them.

When a force acts upon a body and that body moves in the direction of the force, that force is said to do work, and the work done by it is measured by the product of the force and the space through which the body has moved in that direction. Work is usually expressed as foot-pounds. The work of one foot-pound is equivalent to lifting the weight of one pound a distance of one foot against gravity.

Power, in mechanics, is the performance of a given amount of work in a given time, and is expressed as foot-pounds per second, foot-pounds per minute, and, so on. The horsepower is a unit of power adopted for engineering purposes. One horsepower is equal to 33,000 foot-pounds per minute, or 550 foot-pounds per second. The kilowatt, used in electrical work, is equal to 1.34 horsepower.

The importance of a force not passing through a point is called the moment of that force round that point. It is equal to the amount of the force multiplied by the shortest distance from the point to the line of application of the force. The moment is measured in inch-pounds or foot-pounds, but it is necessary to observe the distinction between foot-pounds of statical moment and foot-pounds of work. In mechanics, the moment is usually measured in inch-pounds while work is usually measured in foot-pounds. This practice helps to make the distinction more apparent.

Forces have three characteristics: magnitude, direction, and point of application. When these three factors are given, the force is definitely established. Forces may be represented by straight lines; the length of the

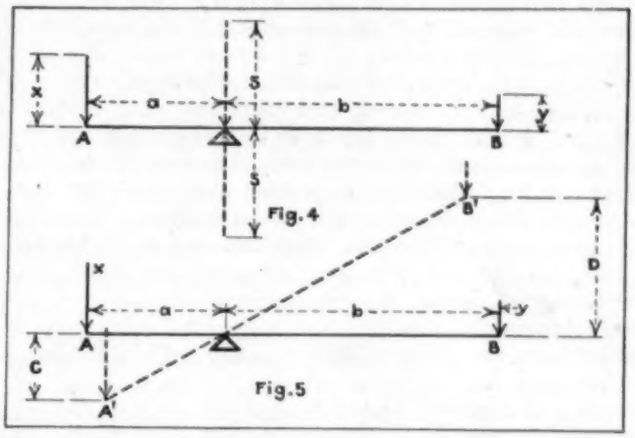


Fig. 4—Forces acting on a lever at rest. Fig. 5—Work done by a lever in changing its position

line indicating its magnitude, an arrowhead at the end of the line indicating its direction, and the position of the line indicating its point of application.

When two or more forces act simultaneously on a body, it will obey each as though the others did not exist, according to Newton's second law of motion. A single force that would produce the same effect upon a body as two or more forces acting together is called their resultant. The separate forces that can be so combined are called the components. The operation of finding the resultant is known as the composition of forces, while the operation of finding the components is known as the resolution of forces.

As an example, if the two forces represented in Fig. 1 by the lines *AB* and *AC* are applied at point *A*, we can assume that force *AB* acts first; and then *AC*, as represented by the dotted line *BD*, which is parallel to *AC* and equal to it in length. The diagonal line *AB* would then represent the resultant, or the single force that would have the same effect as the two single forces acting in different directions.

As a second example, if the four forces represented in Fig. 2 by the lines *AB*, *AC*, *AD*, and *AE* are applied at point *A*, we can assume that force *AB* acts first, then *AC* as represented by the dotted line *BF*, which is parallel and equal in length to *AC*, then *AD* as represented by the dotted line *FG*, and then *AE*, which is represented by the dotted line *GH*. The resultant is represented by the dotted line *AH*.

As another example, if we resolve the force represented by the line *AB* in Fig. 3 into its components at right angles to each other, we draw the parallelogram as shown in dotted lines, with the line *AB* as its diagonal. The dotted lines *AC* and *AD* then represent the components of the force *AB*.

In the final analysis, the forces acting on or through gear teeth may be resolved into equivalent forces acting

on simple levers. We will therefore consider briefly the moments of forces on a simple lever. Fig. 4 is a diagram of a simple lever with a force x acting at A at a distance a from the fulcrum, and a force y acting at B at a distance b from the fulcrum. If the effect of these forces is equal, their moments about the fulcrum must be equal. Hence $ax = by$. If the force x is double the force y, the distance a must be one-half the distance b, etc. Assuming a lever of no weight, the stress between the fulcrum and the lever is equal to the sum of the two forces. This stress exists in both the lever and the fulcrum, and the two stresses are equal and opposite, as represented by the dotted lines. When s represents this total stress we have: $s = x + y$.

As long as the lever is stationary, no work is done. Fig. 5 is a diagram of the lever in two positions, indicating movement. When the lever is moved, the point A has moved a vertical distance equal to C, and point B a vertical distance equal to D. These distances C and D are always proportional to the distances a and b respectively. Ignoring friction, the work done is equivalent to lifting a weight corresponding to force y to a height of D, or a weight corresponding to the force x to a height of C. Thus the work done is equal to the product of the force and the distance through which it has acted. When a shaft is substituted for the fulcrum of the lever, and pulleys or gears are substituted for the lever, the foregoing conditions still hold true. In Fig. 6 we have the force x acting on the pulley A whose radius is equal to a, and the force y acting on the pulley B whose radius is b. The product of the force x and the distance a is the moment of the force x in respect to the axis of the shaft and is also the torque on the shaft produced by the force x. The torque is the moment of the force acting on a shaft in respect to its axis and is usually measured in inch-pounds.

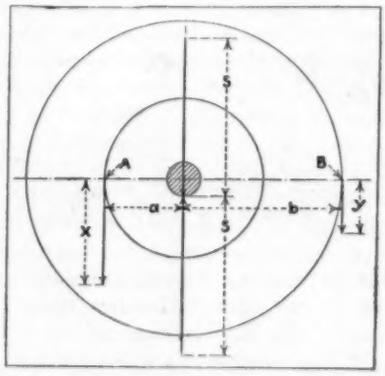


Fig. 6—Analogy between a lever and a set of wheels

A stress s as indicated on the diagram will exist between the shaft and its bearing. This stress is equal to the sum of the forces x and y, and is known as the bearing pressure. When the pulleys revolve, the work done is equal to the product of the force and the distance that the circumference of the pulley on which the force is acting has moved. The rate at which the work is done, or the power, is measured by the amount of work done in a given time. The more work that is done in a given period of time, the more the power that is employed to perform it. Or if the same amount of work is to be done in a shorter period of time, the more the power that will be required.

As there is still a tendency in some shops to use the terms "limits" and "tolerance" interchangeably, it seems advisable to keep on pointing out the difference until the confusion no longer exists. Limits are the actual maximum and minimum dimensions. Tolerance is the difference between the limits.

Solving a Helical Gear Problem by Unconventional Methods—Discussion

By Henry J. Eberhardt

The "Unconventional Method," used by Earle Buckingham on page 327, Vol. 65, of the *American Machinist*, for solving the problem of cutting a helical gear of small helix angle on a hobbing machine that is equipped with synchronized gear trains is an interesting mathematical calculation. However, in these days of competitive production pressure, the method is open to criticism.

Many years ago, the writer waded through change-gear lists and a table of factors, published by the Carnegie Institution of Washington, D. C., which gave factors for numbers up to 10,017,000, for the purpose of getting the change-gear ratios for a train of three helical gears that had to interchange with gears then in use—a severe specification. The influence of small angles and fine feeds made it extremely difficult to obtain factorable numbers.

These mathematical gymnastics are entirely overcome on a modern hobbing machine. The procedure ordinarily followed for the Newark gear hobbing machine would be to find the minimum helix angle to just meet two adjacent teeth. Normal-pitch hobs are used.

Using the same example as referred to, we have a 6-pitch gear, 14-in. pitch diam., and 4-in. face. Then for the minimum helix angle,

$$\text{Sine of helix angle} = \frac{\text{Normal circular pitch}}{\text{Face}} = \frac{0.5236}{4}.$$

Helix angle = 7 deg. 31 min. 20 sec.

With 82 teeth, an angle of 12 deg. 31 min. 40 sec. is obtained. This angle gives more than the desired end thrust. With 83 teeth, an angle of 8 deg. 51 min. is obtained. This is about 1 deg. 20 min. larger than 7 deg. 31 min., and is thus satisfactory. The lead is 282.478 in., which, when divided by 83 gives an axial lead for each tooth of 3.4033 inches.

This axial lead value for one tooth is the same on all gears in the train, regardless of the number of teeth. It is the value that controls the proper tooth bearing, and it remains the same for any number of teeth and for any feed desired. The feed is chosen to suit the material to be cut, regardless of ratio of the gears.

With a machine having a lead number of 2 in., the lead gears for 3.4033 in. are sought. Using the Meyncke logarithms, which give close ratios quicker than continued fractions or tables of factors, for the ratio 3.4033 : 2, we find this combination:

$$\frac{61}{47} \times \frac{59}{45} = 3.4033097 \text{ in.}$$

$$3.4033097 \times 83 = 282.474 \text{ in.} = \text{lead for 83 teeth}$$

By the above method, we usually have small angle helical gears cut before change gearing can be calculated for the older type machines that require synchronized feeds and leads.

It will be noticed that very few steps are taken to solve the problem of cutting these gears on a modern machine. Furthermore, the chief advantage is the fact that with this method the machine will cut the actual gear desired. It is not necessary to approximate the gear to suit the machine, or to suit the gear to the peculiar method of figuring required by the machine's limitations.

Developing Railroad Shop Foremen

By J. R. Leverage
Assistant Master Mechanic, Albuquerque Shops, Santa Fé System

No plan is self-operative—That a foreman is born, not made, is only half true—Results, not methods, should be insisted upon—Training understudies

RAILROADS have devoted a tremendous amount of scientific attention to the selection and improvement of materials. If a piece of material fails, it is sent to the laboratory for the most critical and minute analysis. Specifications are then drawn up indicating the correct sort of material that will fulfill the requirements and function properly. A great deal of time and money is likewise spent in building modern up-to-date shops and engine houses and equipping them with improved machinery and other worth while facilities. If it is deemed important (and it is important) that great care be exercised in selecting materials, supplies and mechanical equipment, and that due attention be given the economic handling of such materials and equipment, it is equally important that due care be exercised in the selection and development of the men who are to man these shops and use this material and equipment, particularly those men who are responsible for the output of the shop, for securing maximum efficiency from each individual in the shop, and from the group as a whole, namely the railroad shop foremen. No men in a railway organization occupy more trying or strategic positions. If the full value of their services and the cost of their errors and mistakes were realized, greater care would be exercised in their selection and development.

In railroading, as in other lines of industry, more systematic methods must be employed to improve skill and to prevent men of talent from being side-tracked in blind alleys; to prevent incompetent untrained men from being placed in responsible positions; in brief to prevent the deplorable waste due to human inefficiency. We insist upon a reasonable amount of skill and training on the part of those who operate tools or machines, but how about the selection and development of those who control and direct comparatively skilled and successful workers? Is it wise to leave this selection and development to chance or favoritism?

There is a wide-spread belief that foremen are born, not made. This is but half true, but were it wholly so it would only emphasize the necessity for greater care in their selection. But is it any more true that good foremen are born, not made, than that good mechanics, good doctors, good lawyers, good salesmen, are born, not made? In either case, does it not require training and experience in addition to natural talent? It is very evident that some men are born with talents for leadership, just as others are born with talents for surgery or for mechanical pursuits. But these talents must be developed and not allowed to deteriorate or run amuck.

A foreman has to deal not only with materials but with human nature. Human beings are extremely delicate, highly-complicated pieces of mechanism. No two are exactly alike, nor do they react in the same way to the same kind of approach or treatment. The foreman is constantly dealing with human nature, investigating, inspecting, influencing, correcting or disciplining men. His job is one of discharging responsibilities, and everyone, no matter how gifted he may be in natural resources, has much to learn before he can discharge these responsibilities to the satisfaction of the management.

The old-fashioned apprenticeship system has fallen into the discard, and we are confronted with a lack of material from which to develop foremen. While a foreman should possess other than purely mechanical attainments, he must first of all be a thorough master of his trade

The foreman is the connecting link between the men and the management. He is the official with whom the rank and file come closest in contact. He embodies to them the corporation. He is the company's man. As such he is largely responsible for the loyalty of the working forces. If he is fair and considerate in all his dealings with his men, the men are likely to feel that the corporation is ready to give them a square deal. If he is grouchy or self centered, short or rough with them, the ill feeling engendered will in all probability extend to the corporation he represents.

A foreman should have knowledge of the work he is to supervise, but mechanical ability alone is no guarantee of his success. He must have tact and diplomacy, be able to create friendly relations and command the good will and respect of all with whom he comes in contact, and to inspire his men with joy and pride in their work. He must be able to delegate certain work to others, must guide and watch his men, but not be so busy with routine work as to lose sight of the larger, more important phases of his work. He must be able to co-operate with the management, with his immediate superior and with other foremen. He should also have

From Advance Topics for 1926 Year Book of the International Railway General Foreman's Association.

good health and physique, and be a man of good moral character.

Upon his success or failure depends the efficiency of his shop. He must be able not only to so plan his work and so organize his forces as to obtain maximum output from the men in his charge, but he must also build for the future, and loyally carry out the policies of the management. If we can be made to realize the importance of the railway foremen's jobs and the necessity for greater care in their selection and development, ways and means will be found for bringing about the desired end. The purpose of this paper is to emphasize the necessity for developing foremen, to suggest methods that have proved to be effective and to invite discussion.

One of the easiest and most successful methods is to provide an understudy for each man in an official capacity. Let the successful foreman take a competent, carefully selected man under his wing and personally train him to follow in his footsteps, giving him the benefit of his experience. Giving him a chance as opportunity offers to try out and develop his ability, not only in the absence of the regular foreman but at other times when the successful foreman is at hand to note and correct his mistakes.

Helping the Student

No one can learn to swim without getting into the water. This does not prove that swimming lessons are not of value. But the instructor must not hold his pupil up all the time. He must let him try it alone. But it is well for the instructor to be near at hand to keep his pupil from going into too deep water, and to save him in time of need. But only by going it alone can the learner actually learn to stay on top.

No one can learn to run a machine without actually being given a chance to run one. Neither can one learn to manage men, necessarily much more difficult to handle than machines, without being given actual experience in managing them. But this does not mean that he must go it alone, any more than that the green hand should be given a difficult machine to operate and be told to go it alone. The damage the green hand might do to his machine would be as nothing to the damage that might be done to the morale of the working forces by an ignorant and untrained foreman.

It is admitted that a man must learn many things for himself. It is equally true that much time and grief of the foreman and of his men, and of the company for whom he works, may be saved if he is given an opportunity to profit from the lessons others have learned. But care must be taken not to cramp or hamper the initiative of the understudy. Let him use his originality. His methods may prove better than those of his instructor. If there is one thing a promoted official must guard against, it is to expect his successor to do everything just as he did it. Results, not methods, should be insisted upon. This should be recognized in the development of foremen through understudies.

One serious difficulty of this method of foremen training, lies in the selfishness and weakness of a narrow-minded leader who refuses to give an understudy the full opportunity for development, fearful least he may get his job or surpass him in competition for promotions. Such disloyal, shortsighted leaders should be relegated to the discard. No man is worthy of promotion unless he has some one trained and ready to take the place vacated by him. This fact should be made plain to all desirous of advancement, and should be demonstrated when promotions are made.

Ambitious men showing possibilities for advancement should be encouraged to pick out some successful foreman or executive and study him, ascertaining what qualifications he possesses that have led to his success, what weaknesses may have held him back. Foremen should assist good men in their respective gangs, taking them under their wings, explaining to them at times why certain executive actions are taken, and giving them such fundamental knowledge as will assist them in filling temporary vacancies and preparing them for properly handling men, material and executive work. There are comparatively few secrets with which these men may not be made familiar. As opportunity offers, such men should be tried and given an opportunity to develop. In this way a ladder may be built up for consistent advancement all along the line as necessity occurs. If each foreman will see to it that he has someone ready to take his place, the problem of securing competent supervision will be largely solved.

There is a great field for training in regular meetings of foremen of departments having similar aims and purposes, similar difficulties and problems. Such meetings, if rightly conducted, are fruitful of excellent results. Much depends on the ability of the chairman to draw out his men, to get them to think intelligently, to express themselves without fear of rebuke or ridicule. Set papers are of value to the man preparing them, but usually of questionable value to others, except as a means of opening or inviting discussion. Too often such meetings are little more than self-admiration societies, in which those present delight in telling their own superior virtues or abilities, or in which those responsible for errors contrive to pass the buck to someone else. Too often they are used merely for raw hiding purposes, nothing being considered except increased immediate output, the only subjects discussed being methods of rushing the immediate work more quickly. Often the effectiveness of these meetings is crippled by the time at which they are held. If such meetings are to be effective, they should be held at an opportune time, presided over by a competent chairman who is capable of intelligent thinking and discussion on suitable subjects.

Subjects for Discussion

In the regular monthly meetings of the supervisors' association at Albuquerque, various subjects pertaining to some particular part of a locomotive are discussed, for example: The functioning of valve gear, superheaters, locomotive boosters, feed water heaters, handling of men, etc., a main paper is generally read by one of the foremen, being followed by open discussion.

It is often well to submit to men under training, a series of questions to study and answer. Such questions will teach them to think and observe, greatly broadening their knowledge and increasing their usefulness. The questions should be carefully prepared with definite aims in view, and may pertain not only to materials and equipment, to rules and instructions, but also to phases of managerial ability. One prominent road is requiring its foremen to write out answers to a list of questions submitted periodically, the person examined being permitted to find the answers wherever he can, and being later furnished a correct set of answers. The purpose of these examinations is not to

find out the weakness of the foreman examined, but rather to increase his knowledge and make him more studious and observant; in brief to develop him into a better foreman.

Formal lectures may be used to advantage. They may be given either by company officials or by experts without the organization. Both classes of lecturers have their value. The outside lecturer is often a better speaker, more likely to talk in the language the foreman understands and to make more definite application of the points brought out. Moreover, his hearers realize that he knows whereof he speaks. But any lecture will prove of little value if it merely passes out information without a desire for that information having been created. Men should be trained to think for themselves. Informal discussions led by skillful chairmen will generally do more to create intelligent thinking and to increase the efficiency of men doing real jobs, than can possibly be secured by the more forcible lecturer.

It is well for the foreman's training that he be allowed to visit other shops and talk with others doing similar work, but perhaps in a different way. It is sometimes better for two to go togther, the better to observe and study matter of interest. At times they should be told in advance what to look for. In all cases a report should be required, together with opinions as to the value of the methods observed. In connection with this feature of foremen training, I would mention a visit to our road by a delegation of motive-power assistants of one of the prominent eastern railroads, who brought with him seven of his foremen, together with a stenographer. These men visited several of our shops and took ample time to look into matters of interest both as to equipment and shop practices. Each one was assigned one or two items to look up each half day, after which they assembled daily for joint discussion of what they had observed or learned. They then wrote their notes while still fresh and hot. You can readily see the possibilities for training in a visit of this kind.

Trade Journals as Aids

Prospective and embryo foremen should be encouraged to read and study railway and trade magazines, also trade catalogs descriptive of machinery and materials. The making of a scrap book from technical and other publications on subjects of definite interest is of value, not only for the information therein contained for ready reference, but for the knowledge gained in its preparation. The officers of our system supervisors' association send out periodically, a printed letter full of inspiration and helpful suggestions to our foremen. These letters have been very valuable. We should mention also the inspiration and other benefit a foreman receives from attendance at general conventions, taking part in the discussions, and mingling with others engaged in similar work, talking between sessions of the convention, at meal times, in the hotel lobby and on the train en route to or from the place of meeting.

One of the best means of developing a foreman, as well as of increasing output, is to impress upon each man in official capacity his personal responsibilities, making him realize that he is absolutely responsible for the repairs and assembling of all equipment coming through his department, and that he is also responsible for material coming from other departments in connection with the output of his department. For example, in the Albuquerque shops, we have three erecting foremen, each having eight or nine pits. These three foremen have been trained to understand that they are each strictly responsible for getting the machine work in due time from the machine foreman, also, each one is given to understand that he is responsible for boiler test dates, as well as for tanks, lagging, jacket pipe work, etc. In other words, he is responsible for the engine from the pilot to the rear of the tender. The machine and boiler foremen realizing this are also insistent upon the erecting foreman getting the engine stripped, material delivered, and new parts ordered, so that he will not be delayed in returning this material to the erecting floor. In so doing, each one is taught to respect the other fellow's position and particularly to respect the workmen or craftsmen coming directly under his immediate supervision, and at all times to see that there is no friction between the one department and the other.

Daily Meetings

Friction between departments has been practically eliminated, due to the fact that all departmental foremen are called into the office for fifteen minutes at 9.00 a.m. each morning. In this brief time we discuss the requirements from the various departments, as well as store department material. Excellent results have been secured from these meetings. There is a correct understanding between all departments. Misunderstandings that might otherwise be conveyed by various departments are eliminated, and all realize that they have the hearty support and backing of their superior officers on their wants and requirements.

One of the best means of developing railroad shop foremen is a modern up-to-date apprenticeship system. This not only serves to supply the road with competent mechanics for the rank and file, but incidentally prepares very desirable material for official positions. The graduates are skilled mechanics with an all around training. Their knowledge of drawing enables them to read blue prints readily and to make intelligent sketches when desired. They have been made familiar with company standards, company, state and Federal rules, etc. Their athletic and other apprentice club activities have aided in developing leaders. Naturally, the more competent forge to the front and prove valuable material for developing shop foremen. Two hundred and forty of the young men who have served their apprenticeships under the up-to-date methods in vogue on the road with which I have the honor of being connected, are now holding foremanships or other official positions on the road and are making good on the job. This number includes 65 assistant roundhouse foremen and roundhouse gang foremen, 38 machine and erecting foremen, 18 boiler foremen, 6 car foremen, 23 general foremen and 7 division master mechanics.

All are young men with unlimited opportunities before them, and as they are further advanced other graduates are being made ready to follow in their footsteps. Promotions, of course, are not restricted to apprentice graduates, but each vacancy is filled by the appointment of the most competent employee available, all employees being made to realize that promotions depend on merit alone. The policy of the management of promoting from within the ranks has had a very wholesome effect in making the employees satisfied, in encouraging them to fit themselves for promotion, and in creating in them a feeling of loyalty toward the road. its officer and its policies.

The methods herein mentioned have all been found to be of value. Suggestions as to other methods known to be effective will be most welcome. The subject is a big one, worthy of consideration by big men. No plan of developing competent foremen will be found self-operative. Any successful plan will require the brains and thought and study of master minds. In the end, results will demonstrate the value of the attention given this phase of railroad work. No body of men will be found more susceptible to training than railroad foremen. They are ambitious and anxious for greater responsibilities, and will take full advantage of all opportunities given them for advancement. They are intensely loyal to the company and are ever ready to carry out company policies, once such policies are known. From their number and from those hereafter selected for minor positions, the future executives will later be chosen.

In concluding, let me stress the point that the successful foreman will inspire that wholesome interest and loyalty to the workers that he himself gives to his superiors and to the plant as a whole. He will not expect service unless he is consistenly giving it. He must not only set the example, but practice it. When he censures or when he commands action on the part of the workers in his department, he must have just cause. Passing judgment on one's fellowmen should only follow thoughtful consideration. He who would rule must first learn to obey.

Employment Responsibility of an Executive

By Leslie Childs

TO THE man occupying a subordinate position in an industrial establishment, his superintendent or manager may appear a law in himself, in so far as the performance of his duties is concerned. While it is true that an executive may not be discharged or disciplined as readily as a subordinate, yet, the idea that he accounts to no one but himself is usually all wrong.

Regardless of the rank of an executive, he usually has a president, a board of directors, or other governing power above him to which he must account. It follows, that a willful disregard of instructions may render him subject to removal like any other employee. Just what may constitute grounds for the discharge of an executive depends upon the facts of each particular case, and as an example of judicial reasoning on the question an actual case is given from the Wisconsin courts.

In this case a superintendent was employed by a company and placed in charge of its shops. The contract of employment was for one year at a salary of $6,500, with a bonus depending upon the output. At that time the company had a contract to manufacture several thousand machines for future delivery, which required prompt action on its part. The superintendent was unable to secure the required production, and in a few months his company was behind on its deliveries.

In this situation the buying firm complained, and the vice-president of the company, accompanied by the superintendent, went to a distant city for a conference. Following this, the vice-president instructed the superintendent to go back to the shops as soon as possible, and the latter promised to do so.

The superintendent failed to keep his word, stopped off in another city, and as a result was absent from the shops several days. For his failure to return promptly to the shops he was discharged. He thereupon brought action for damages on his contract.

In this action the superintendent maintained that he had been wrongfully discharged, because in view of his position, his absence from the shops for several days did not constitute grounds for his summary dismissal; furthermore, he contended that it was not shown that his absence caused any loss to his company. The case reached the higher court on appeal, and in stating the general rule, relative to when an executive may be discharged for insubordination, the court, in part, said:

"It is maintained for the appellant that one serving in a supervisory capacity is not so strictly accountable to the employer for his time as is a clerk or workman, and that the absence of two or three days without permission was not such a breach of the contract as warranted its termination.

"But the applicability of such a rule must depend on the facts of particular cases. Conditions may be imagined where in a smoothly running and successful business even a month's absence of a superintendent, who has the business well in hand, might be wholly consistent with its continued successful operation. Upon the other hand, the business may be in a condition so critical that a single hour's absence of such an officer at such a time might well be regarded as rank disloyalty and gross insubordination."

In this case purchasers were clamoring for deliveries and complaining of defects in goods delivered; materials were delayed; there was trouble in the shop; and things generally seemed to be going awry. Surely this was not a situation wherein the man at the helm might needlessly abandon his post.

"It is urged that the evidence shows no harm to the business resulting from the days of absence of its mechanical head. The sentry sleeping at his post is not less derelict in duty if disaster does not follow; nor is the responsible employee's disloyalty measured by the harm to the employer, nor minimized if none happens to follow.

"But the employer did then know the desperate condition of things at home; did know that his superintendent's place was there, and his presence there much needed; and did know that for several days he did not put in appearance at his place of duty. Without any excuse appearing for the absence, such as illness, the employer was warranted in attributing it to a willful disregard of the master's interest, and to insubordination, which, in our judgment justified his dismissal."

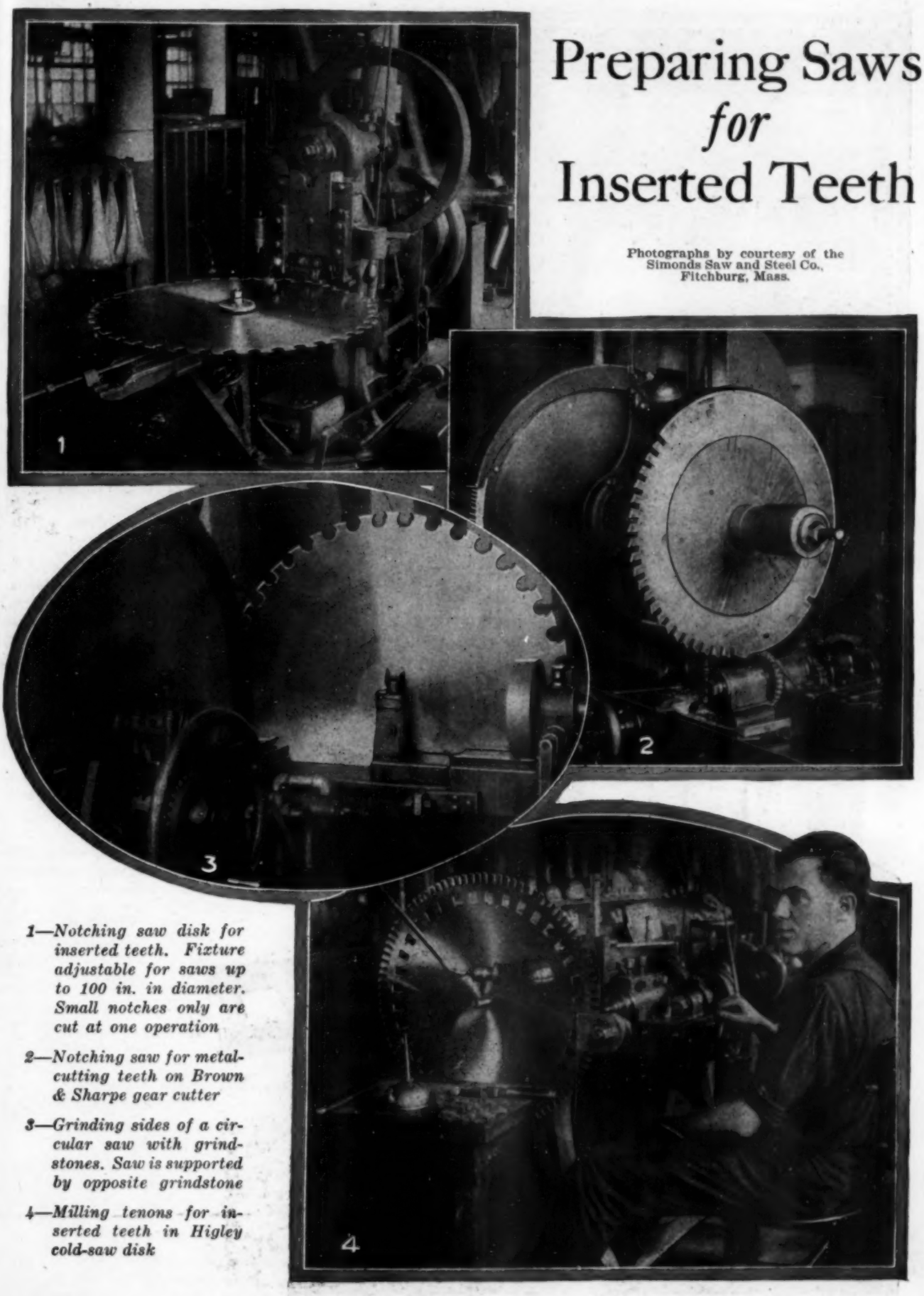
In conclusion the court affirmed an order holding that the superintendent was not entitled to damages, and that, in view of all the circumstances of record, his unauthorized absence from his place of duty for several days justified his employer in terminating the contract of employment.

If the experiments now being made in constructing dwelling houses of cast iron or steel plates develops, the metal worker may have the laugh on the mason and the carpenter.

The white collar job isn't exactly what it used to be. You frequently find white collars in the shop these days as we get more and more machinery that takes the drudgery out of shop work.

Preparing Saws *for* Inserted Teeth

Photographs by courtesy of the Simonds Saw and Steel Co., Fitchburg, Mass.



1—Notching saw disk for inserted teeth. Fixture adjustable for saws up to 100 in. in diameter. Small notches only are cut at one operation

2—Notching saw for metal-cutting teeth on Brown & Sharpe gear cutter

3—Grinding sides of a circular saw with grindstones. Saw is supported by opposite grindstone

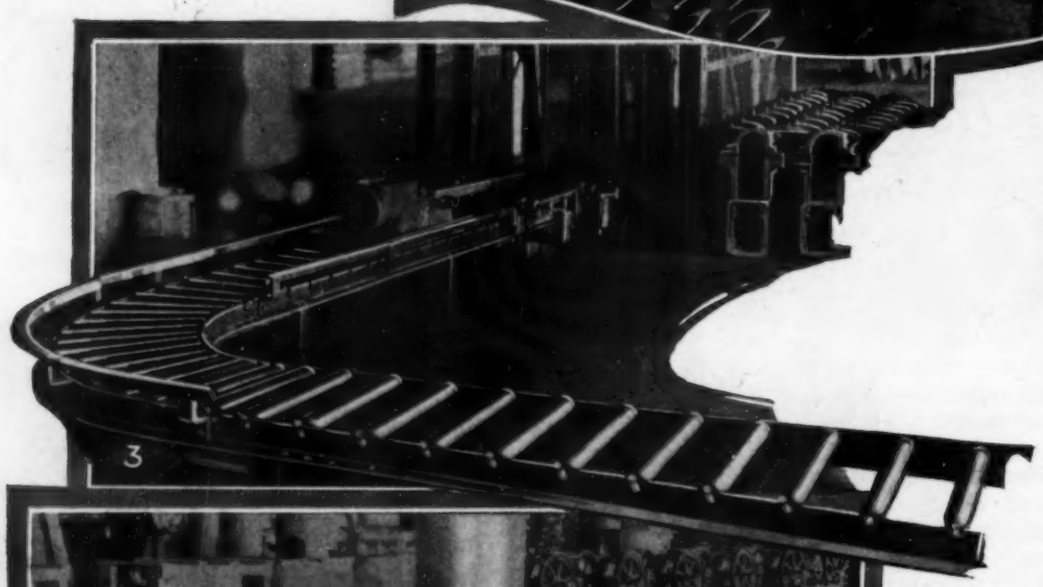
4—Milling tenons for inserted teeth in Higley cold-saw disk

Conveyors in Machine Shops

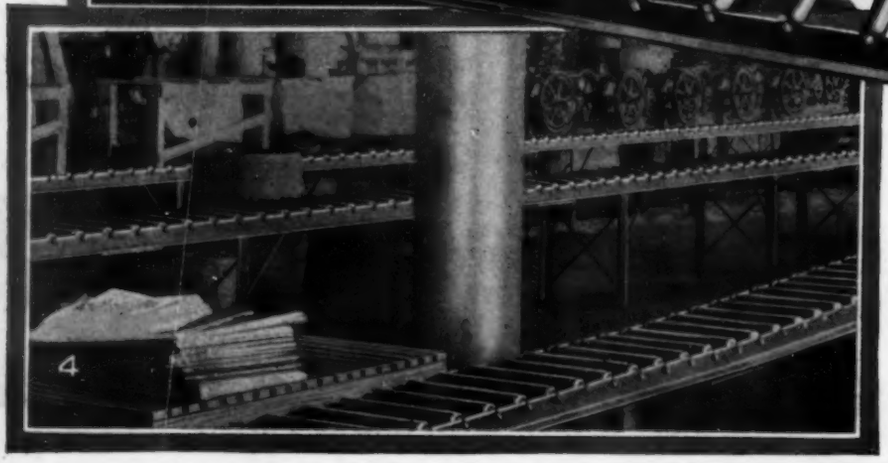
Photographs by courtesy of the Standard Conveyor Co., St. Paul, Minn.

1 — Conveyor system arranged to transport cylinder castings in an automotive shop

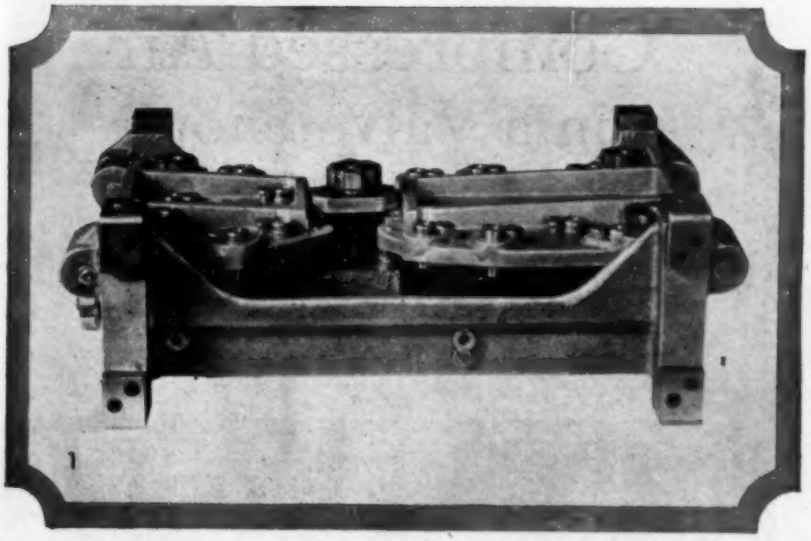
2 — Conveying work from elevator to machine line



3 — Conveying gas-engine castings to elevator



4 — Finished gas engines are inspected and crated on the conveyor



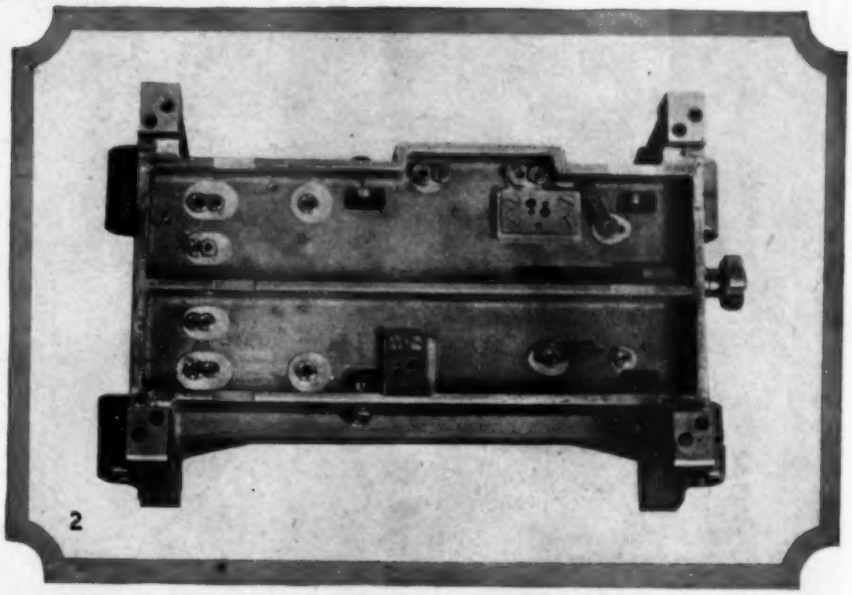
Saving Weight and Energy

The use of light-weight metals for fixtures is being carefully considered where conditions make it advisable. In the fixture shown, the use of magnesium castings so reduced the weight that, with the work in place, the whole thing could be readily handled by a girl, whereas a man would have otherwise been necessary.

The center piece of the fixture is 20 x 11½ x 6¼ in. The two hinged lids are 11 x 8½ x 1⅞ and 8 x 8½ x 1⅞ in. respectively. Yet the finished weight of the fixture is approximately but 17 lb., a saving of at least 30 per cent over aluminum. As can be seen from the different views the fixture is provided with bushings for drilling over 50 holes of various sizes. The machining tolerances are 0.001 in. and three months of service do not indicate changes that affect this tolerance.

Steel bushings are used and the feet and corners subject to wear have steel faces. The parts of the fixture machined very easily and, while the castings cost about two and one-half times as much as aluminum, the total cost of the finished fixture was increased only 5½ per cent. It is believed that there are many other places where the use of very light metal would increase production, such as templets for laying out work.

The fixture is shown clearly in Figs. 1, 2 and 3. It was made by the Buerk Tool Works, Buffalo, N. Y. for the Todd Protectograph Co. of Rochester, N. Y. The castings were furnished by the American Magnesium Corporation, Niagara Falls.



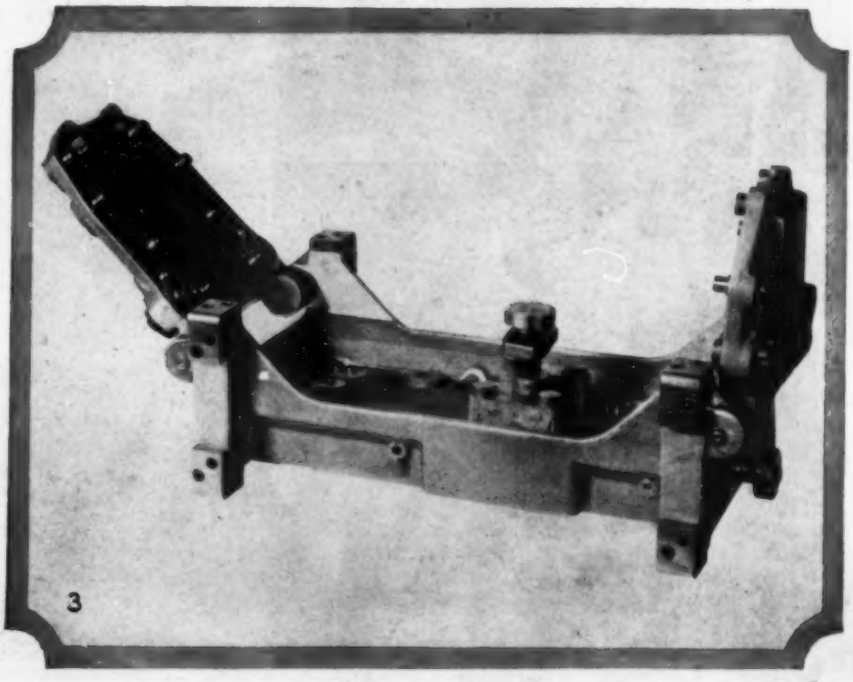


Fig. 1—Fixture closed but without work in place

Fig. 2—Bottom view showing drill bushings and clamps

Fig. 3—Fixture made of magnesium castings

Compressed Air in a Valve Shop

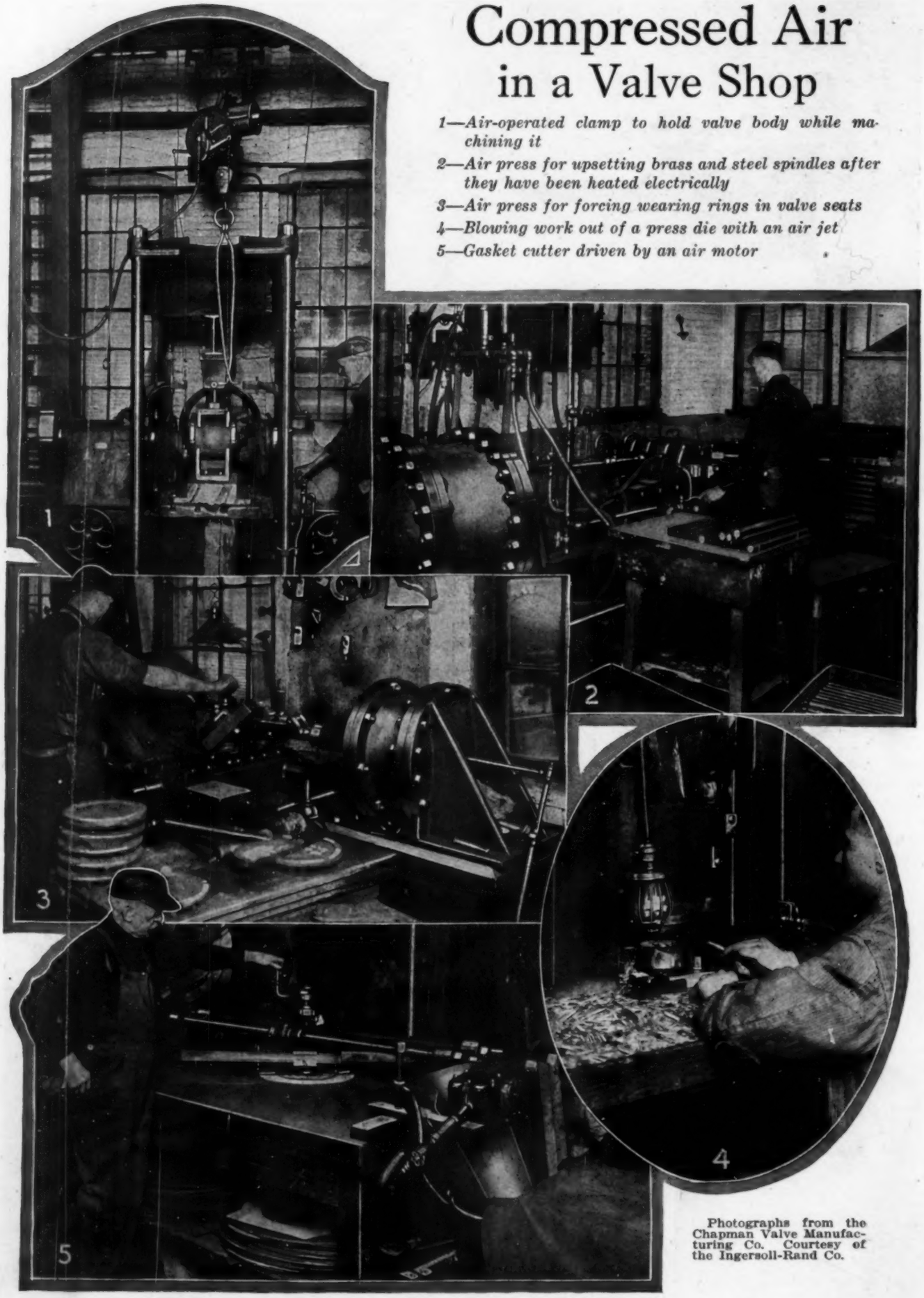
1—Air-operated clamp to hold valve body while machining it

2—Air press for upsetting brass and steel spindles after they have been heated electrically

3—Air press for forcing wearing rings in valve seats

4—Blowing work out of a press die with an air jet

5—Gasket cutter driven by an air motor



Photographs from the Chapman Valve Manufacturing Co. Courtesy of the Ingersoll-Rand Co.

Lower Costs by Waste Elimination

By C. B. Auel
Manager, Employer's Service Department Westinghouse Electric and Manufacturing Co.

Lack of standardization has more to do with the high cost of living than any other one thing—A salvage department to study and correct apparent losses

WHILE more or less attention has been given to the larger items of waste by practically every concern in the manufacture of its product, it is undoubtedly a fact that the subject of waste elimination, as a whole, has not yet received the attention it deserves from a great many concerns. Notwithstanding the articles which have appeared from time to time in the press, or the efforts which have been made by various organizations and individuals, the movement toward waste elimination is slow in getting under way.

The Department of Commerce is to be commended not only for its accomplishments in this field, but also for the further staging of a campaign each year to bring the matter to the attention of the rank and file of our people generally.

To account in part at least for this seeming lack of appreciation as to the necessity for improvement in our present ways, it may be said that waste assumes so many guises it fails at times to be recognized. For example, the disadvantages of the great lack of standardization in this country are not at all recognized by the average man or woman. And why should they be, when so many of our wares are advertised not because they are standard, but because they are not, until the buyer thinks an article, if labeled "special," must surely be of superior merit.

So many of our wares are advertised not because they are standard, but because they are not. . . . that the buyer thinks an article if labeled "special," must be of superior merit. Disadvantages of the great lack of standardization are seldom recognized

Yet this very lack of standardization probably has more to do with the high cost of living than any other one thing. It means increased cost of an article in the first place, more frequent replacement in the second place, as well as difficulty in securing duplicates at any price.

As far as the industries are concerned, increasing competition is commencing to furnish the incentive to hasten simplification and standardization in this country, as also the elimination of wastes of other kinds.

It is not overstating the matter to say that the time will come in the manufacturing industries when waste elimination and prevention will receive as much recognition as the products regularly manufactured, for profits can be made in this way, as surely as by increased sales. This will result in the establishment within the large organizations of "Waste Reclaiming and Prevention" or "Salvaging Departments" in charge of engineers, whose sole duties will be to study every waste, tracing it back to its source in an endeavor to eliminate it; or failing in this to find an advantageous outlet, and by this last statement is meant some disposition of it at better than scrap value.

It seems equally evident that the smaller manufacturing concerns, in which the establishment of a regular department of this kind would hardly be warranted, will find it necessary to call upon consulting engineers, who must stand ready to furnish them similar service, thus enlarging their present field of activity.

In an effort to dispose of one's waste or surplus items, it is surprising to find what diversified markets open up, and it should be borne in mind that if your waste or surplus materials can become the raw materials for other manufacturers, the reverse of this is also likely to prove true, and you should be prepared to avail yourself of these when opportunities offer.

As examples of such items, mention may be made of dulled files, sometimes purchasable at a nominal figure, and which may be resharpened to advantage; misprint salt bags for carrying or storing small packages within a plant and which can be used over and over; used sugar bags which, after opening at the seams and washing, make excellent wiping cloths; short ends of wood, which are sometimes found to be suitable for brush backs; wiping rags which may be reclaimed with proper apparatus or sent to a laundry and washed, etc. The mere fact that purchases, such as these, can from time to time be made to advantage should be quite sufficient to cause one to pause before actually classing as waste any apparently waste items of your own until careful investigation has been made as to the possibility of salvaging them yourself.

It will usually be found that you are your own best customer, and by doing the reclaiming yourself, your losses can frequently either be minimized or actually turned into a very respectable profit. No better example of this need be cited than the reclamation of worn and oily leather belting. By immersing such belting for several hours in gasoline, all oil and grease are removed, after which worn spots can be cut out, the belting re-pieced and put back into the same kind of or a lighter service. The worn pieces if single ply may sometimes be turned into hand leathers or washers, the still smaller pieces sold for the manufacture of boot heels, carbonizing materials, etc., while the reclaimed oil

will do for swabbing dies or as fuel for oil furnaces. If, for any reason, it does not appear desirable to do the reclaiming yourself, the belts may be reclaimed by being sent to concerns who specialize in this sort of work.

Should you be compelled, as you will be in many instances, to resort to outside agencies in order to dispose of your waste or surplus materials, the search to be successful must be made in a consistent and systematic manner. This may be done through a number of channels as follows:

(1) Customers of one's own products.
(2) Users of similar products.
(3) Suppliers of one's raw materials.
(4) Insertion of advertisements in trade papers.
(5) Watching advertisements.
(6) Commission houses.

And if the search for markets must be consistent and systematic, it is equally true that a system must be established within your plant whereby all inactive, surplus and excess materials will be regularly brought to the attention of the salvaging department, so that no items will be overlooked.

On the assumption that the materials entering directly as well as indirectly into the manufacture of your finished apparatus have been fairly well standardized and are carried in stock to a greater or lesser extent, then all such accounts should be reviewed at least yearly by the storekeeper.

In a rather similar manner, work in process should also be reviewed, especially where apparatus is built for stock, instead of individual customers, and all inactive items and parts put up to the salvaging department. This can be done at the annual inventory, or by means of so called "clean-ups" at more frequent intervals. Of course, it is understood before any attempt at disposition of materials or parts is made that the salvaging department will have discussed the situation with the sales, engineering and manufacturing departments, and these departments will be in agreement as to the steps to be taken.

Aside from the more or less obvious wastes, as already given in the various examples, there are others equally important, but rather more intangible. Among these may be listed, the burning of electric lights on bright days or at other times when not necessary; the escape of compressed air, water and steam from leaky joints; the idle running of electric motors and tools, or the use of larger motors and line shafts than are required; the burning of gas fires for solder and babbitt pots and of compressed gases like oxygen, acetylene and hydrogen when not needed.

This situation can be helped by instituting a periodic system of inspection and control by someone directly under the shop management, who has the authority to point out to departments, where they are remiss in matters of this kind.

To keep these matters constantly before the manufacturing departments "elimination of waste" meetings can be held monthly by each departmental head and his assistants. Minutes of these meetings should be kept and copies sent to the shop management for review, and if each month or even occasionally, a guiding circular letter is issued to all departments or even individual letters commending those departments who have succeeded in their efforts, much good will result.

As for the rank and file of the employees, a short and intensive campaign each year or possibly semi-annually should be staged, and no better time can be selected than that week which has been requested by the Department of Commerce to be designated as management or waste elimination week. The coming of this week can be advertised by bulletins.

Each department can arrange to have a table of exhibits showing the items used in the largest quantities and what they cost; or where the items themselves do not lend themselves to actual exhibits, as in the case of electric current, water, steam or gas, placards can be posted giving information as to them. The average worker has little idea either as to the amount or cost of materials used, especially of expense materials that he comes in contact with every day, and anything along this line will have a certain amount of educational value.

Included in these exhibits can also be samples of the raw materials used, and of the partially finished pieces en route to the completed apparatus. The exhibits should have a neat appearance and the tables on which they are arranged can be covered with wrapping paper, while the placards can be done with a set of stencils or free hand by the artist who marks the addresses on the boxes of finished products, as they are shipped from your plant.

Pyrrhic Progress

ONE of the many sardonic fruits of the World War is a new mode of progress in business which has been discovered for stubborn Europe.

The Belgian steel plants were demolished by the Germans during the war, so there was no possibility of continuing to operate those plants. They were "done for." With somewhat doleful faces the Belgian steel men set about the task of reconstruction of the steel business. Since there was no way out by utilizing the old plants, the manufacturers set about to install the newest construction.

Now, since these new Belgian mills have been in operation they have produced steel so cheaply that it can be exported into England and sold considerably cheaper than English steel, which is made in old mills, greatly over-manned! The English, not having had their old mills willfully destroyed, cling to them as if they were precious heirlooms.

Thus a devastating fire is shown to be the imperious agent of progress. What a wonderful opportunity for the imagination to guess how much the world would be advanced if its obsolete equipment of every sort were suddenly forcibly taken from it by fire, the ruthless destroyer! Modern men in Europe are literally begging manufacturers there to put in new machinery, adopt new methods. In Germany a lively debate is in progress as to whether it will be better to adopt new American methods at once or wait until Germany can develop her own advanced methods. England is bestirring herself to modernize, but finds it hard to "scrap." The operation is painful, but it must obviously be performed, either by voluntary action, or by fire, earthquake or catastrophe!—*Advertising and Selling.*

Sometimes a man fails to get the best results from a welding outfit because he is too proud to admit his ignorance, and to let the salesman or demonstrator show him how to use it.

Automotive Production

How Production Methods Vary in Shops Building "Light Sixes"

By Fred H. Colvin
Editor, *American Machinist*

Crankpin ends of Overland "Six" connecting rods broached without being bored—Babbitting by the centrifugal method—Single-blade reamer gives fine finish

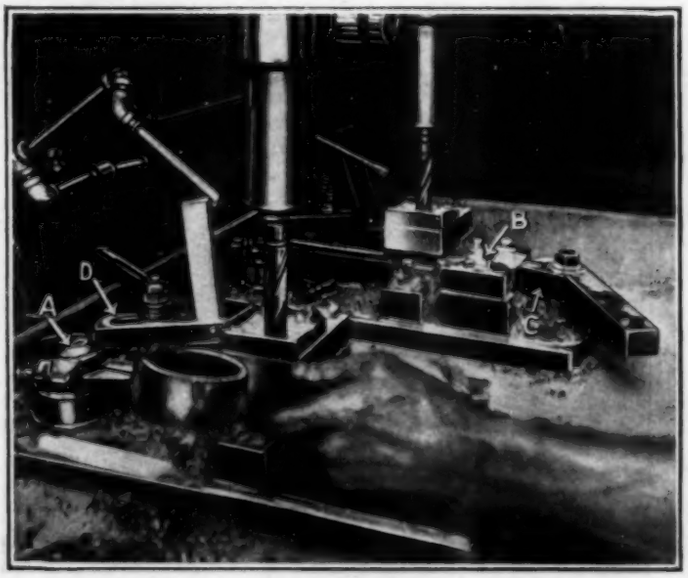
INDIVIDUALITY in design of fixtures and tools, as well as in methods, crops out in the various shops building automobile engines, and we find various ways of manufacturing similar products. A good example is found in the connecting rods for the Overland "Six," made at the Toledo plant of the Willys-Overland Co. After inspecting and straightening the rods, if necessary, the piston pin holes are drilled on the machine shown in Fig. 1. The method of clamping is worthy of special note. The holes in the large ends go over centering plugs, as at *A*, after the small ends have been inserted in the end at *B* that carries a sliding V-block, operated by a cam, as at *C*. After the rods are pushed back against the plugs *A*, the cam-operated clamps *D*, hold the large ends against movement during the drilling.

The large ends are next broached in a double-head LaPointe machine, Fig. 2, right from the forging, the holes having been previously punched in the forge shop. The holes are broached oblong to allow for the saw-cuts in cutting the caps from the rods. The outer ends of the broaches are carried in sliding heads to prevent sagging.

Following the broaching, the bolt bosses are milled on one side of each of four rods at once in double fixtures as in Fig. 3. Two rods are held on each side of the upright *A*, being located by the pins in the piston-pin holes and clamped by C-washers. It will be noted that the two fixtures are staggered on the milling machine table, so that one fixture can be loaded while the cutters are at work on the rods in the other one. In this way the operation is practically continuous on four bosses.

The holes for the clamping screws are drilled, spot faced and tapped, and the large ends of the rods are chamfered for the babbitt. The bolt holes are drilled,

The tenth article. The eleventh will appear in an early issue.



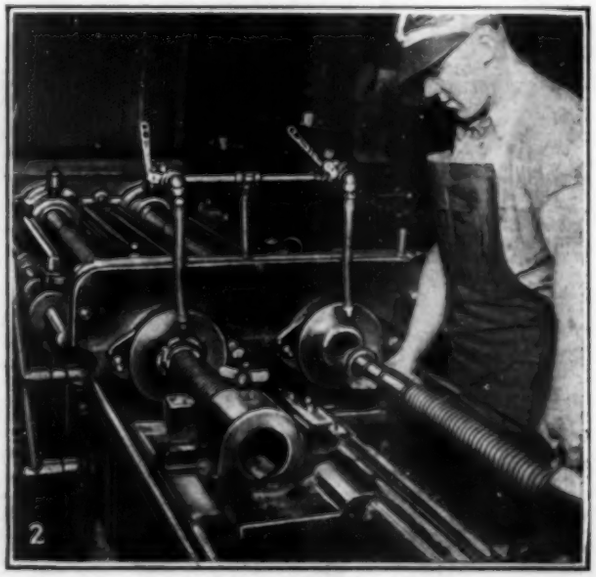


Fig. 1—Clamping fixtures for small-end holes. Fig. 2—Broaching from the rough

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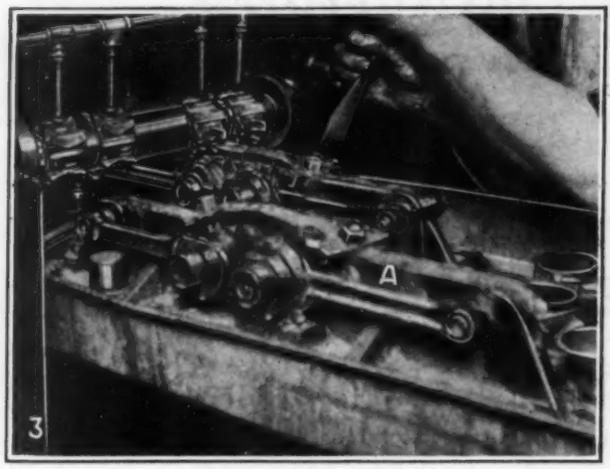


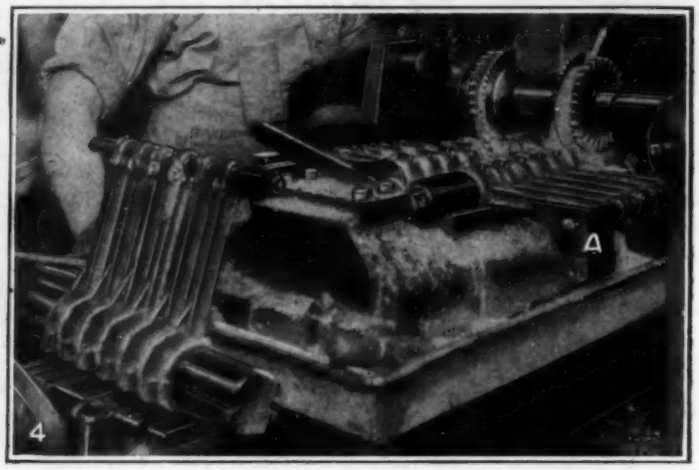


Fig. 3—Milling sides of bolt bosses. Fig. 4—Cutting off caps

reamed and spot faced on the cap ends. Then the rods are babbitted by the centrifugal method, after being cleaned and the inner surfaces coated with acid. Rough boring is next, after which the caps are sawed off in the fixtures in Fig. 4. Mandrels are provided for each end of the rods and six rods are strung on each pair.

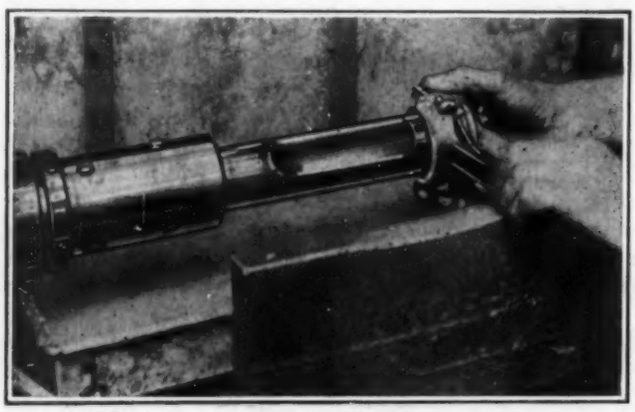
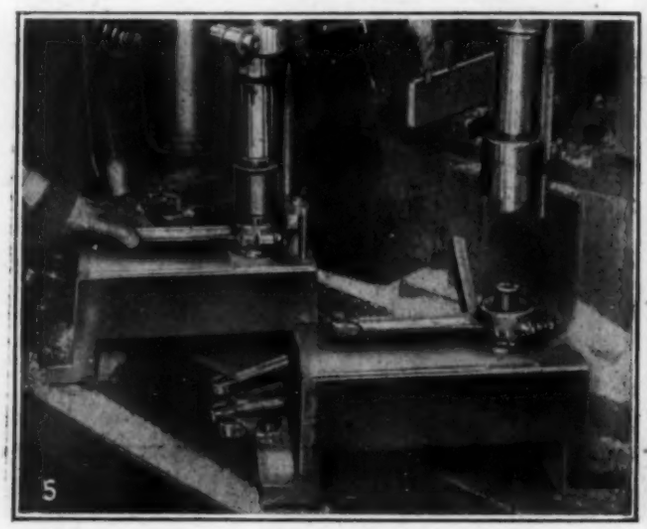


Fig. 7—The final reaming to size

The large mandrel is slotted on each side to allow clearance for the cutting-off saw. The mandrel at the small ends fits into blocks as at *A*, while the large mandrel is clamped in V-blocks as shown. The cutters cut through one side of the caps and face the upper sides of the bolt bosses. Reversing the gangs of rods and taking a second cut completes the cutting off of the caps. Two features of the fixture are the center support for the cutting arbor against the upward thrust of the cutters and the heavy, outbored support for the overarm.

After finish boring the large ends of the rods, they are faced as in Fig. 5. The rods fit over plugs that carry pilots for guiding the facing cutters. The cutter at the left is shown down on one of the rods. Then the rods are sawed at the small ends for clamping the piston pins, as in Fig. 6, three rods being handled at once.

The final sizing of the crankpin bearings is done by a single bladed reamer, used as in Fig. 7. The body of the reamer is only a trifle smaller than the finished size of the holes, the rods just sliding over the end. The single blade removes but a few thousandths, and leaves a remarkably smooth surface, as well as holding the diameter very close to the desired size.



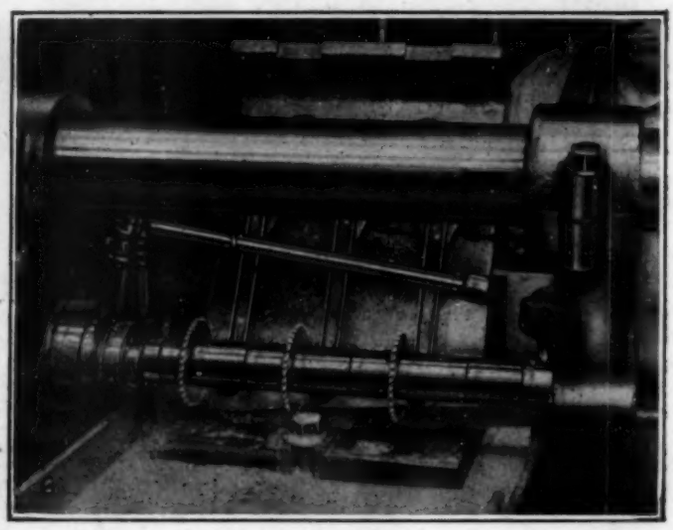


Fig. 5—Chamfering babbitt bearings. Fig. 6—Sawing the clamping slot

Automotive Production

Press Operations on Marmon Steering Gear Parts

By Frank W. Curtis
Western Editor, *American Machinist*

Layout of operations required to form cup—Details of dies used for drawing body—Trimming outside flange—Die for notching eight slots in small end

STEERING-GEAR screw-spring cups for Marmon motor cars are produced by a variety of dies that complete the unit with the exception of the cutting off of the small end. The layout in Fig. 1 shows the procedure in making the cup and the dimensions of the work as produced in each operation. Deep-drawing sheet steel, sheared square to 3¼ in. in width, is used. The blank, 0.037 in. in thickness and 3 3/32 in. in diameter, is made in a stock die of standard design in which a punch and a die ring of suitable size are used.

For the first drawing operation, the die illustrated in Fig. 2 is used. The blank is nested in the counterbored portion on the pressure pad, as shown at *A*. Three pressure pins equally spaced, and located between the pressure pad and the top spring pad, hold the nesting surface of the pressure pad flush with the top of the punch *B* when the press is not in action. The punch is located in the die shoe *C* by the counterbore, ⅜ in. in depth, and fastened by three ½-in. fillister-head screws. The die ring *D* is bored to fit over the punch and has a clearance allowance in it to accommodate the thickness of the work. A knockout pin is mounted in the die to eject the work in the event it binds after being formed. As the die travels downward it strikes the pressure ring causing it to travel in the same direction, while the blank is drawn over the punch. On the upward stroke, the pressure ring ejects the work from the punch unless it is carried up with the die. To provide a pressure suitable to draw the cup three coil springs, 1⅜ in. in diameter, are used. Spring adjustment is provided by movement of the check nuts on the stud.

Following this operation the work is placed in the die shown in Fig. 3 which completes the second form as indicated at *A*. The die block *B* fits the counterbored portion of the die shoe and is held in place by four cap screws. A knockout pin is mounted in the punch so that the work will be ejected on the upward stroke of the press.

In the next operation the work is finishformed in the flattening die illustrated in Fig. 4. The rounded corners are straightened and the flange is flattened as shown at *A*. The die and punch construction is similar to that of the second forming die previously illustrated. A lower knockout pin *B* is mounted in the die as the shape of the finished work is such that it has a tendency to stick in the die. A spring, the pressure of which is adjusted by the check nuts on the stud, is mounted between the washer *C* and the die shoe.

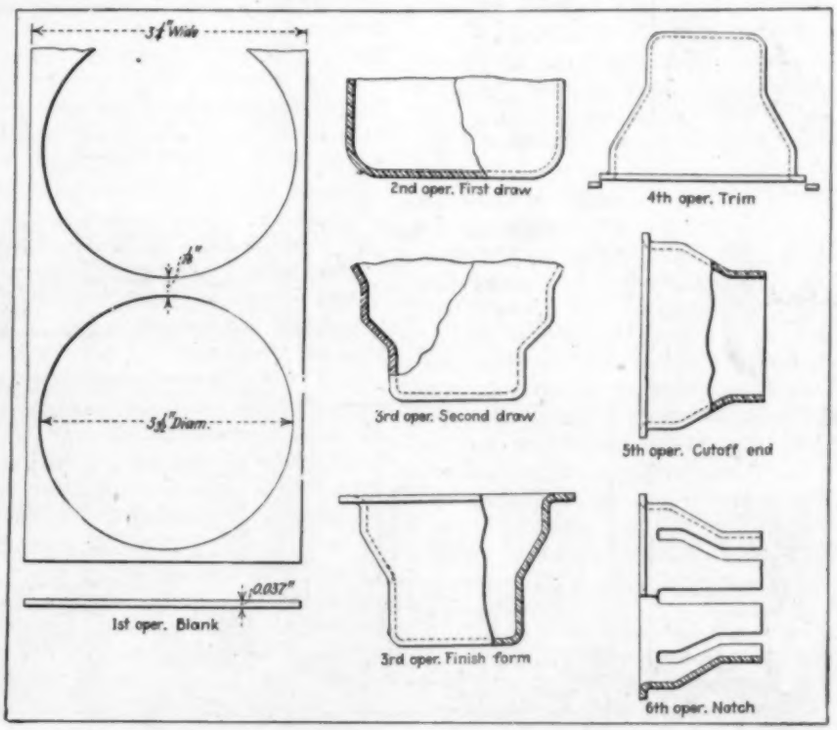


Fig. 1—Layout of operation for forming cup

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Trimming of the formed flange is handled in a sub-press die shown in Fig. 5. The work is located over the plug *A* which is fastened to the punch *B*. The die *C* is attached to the punch holder which is provided with a knock-out pin *D* to eject the work as in the other dies. In order to break up the outer ring that is cut from the flange of the work, three knife pins, as shown at *E*, are located in the punch so that their cutting faces are flush with the face of the die. This feature facilitates the removal of the scrap portion usually left on the punch. Two leader pins, mounted in the die shoe, guide the movement of the punch holder. The guide bushings *G* are made so that they project below its lower face. This operation completes the form of the cup, after which it is mounted on an expanding mandrel in a lathe where the small end is cut off as shown in the layout in Fig. 1. The mandrel grips the work by its 1$\frac{5}{16}$ and 1$\frac{3}{8}$-in. diameters, and locates it from its flanged end.

The final operation is accomplished in the die shown in Fig. 6 in which eight slots are pierced in the outside portion of the cup. The work is placed on the die *A* which is secured

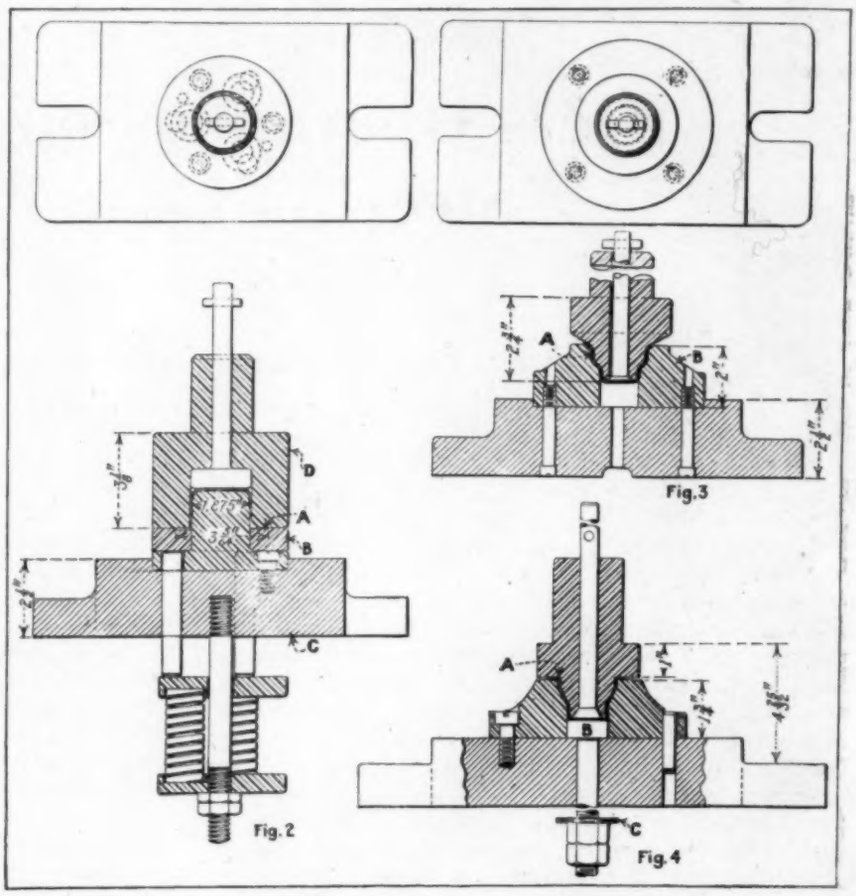


Fig. 2—Details of first drawing die. Fig. 3—Die used for the second draw
Fig. 4—Finishing draw and forming flange

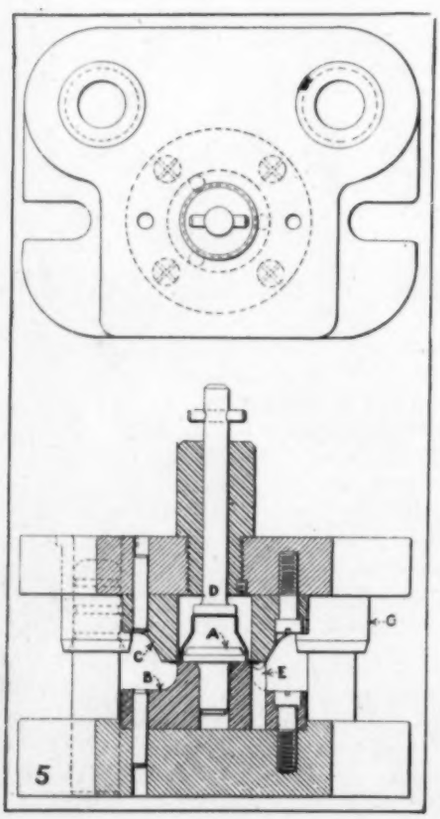
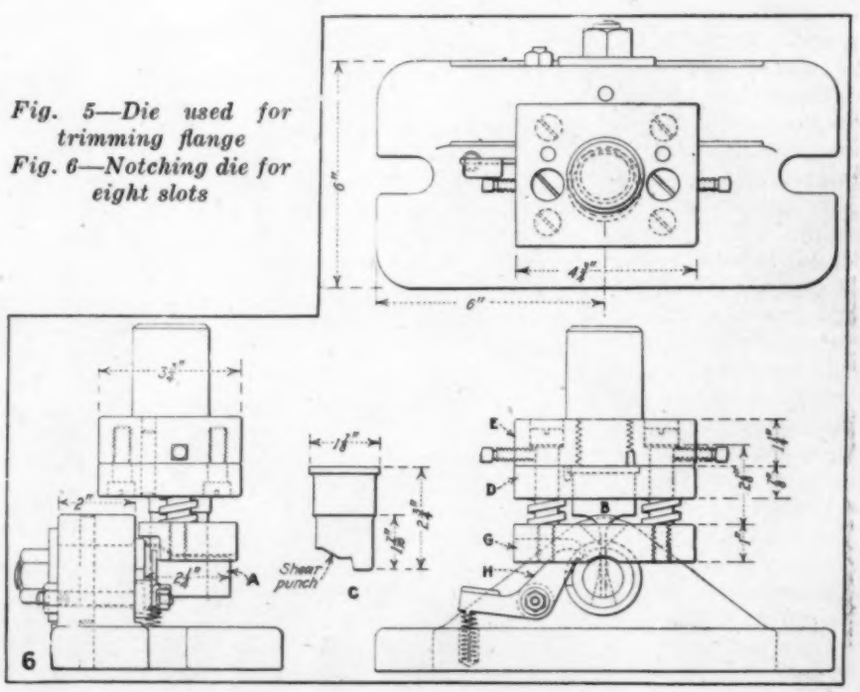


Fig. 5—Die used for trimming flange
Fig. 6—Notching die for eight slots



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in the cast-iron base by its shank end and fastened by a nut and washer as shown. A dowel pin through the shank and the base maintains proper vertical adjustment of the die slot. The punch *B*, details of which are shown at *C*, is carried in the punch holder *D* which is attached to punch shoe *E* by four screws. Two shoulder screws, located in the shoe and in the holder, are used to hold the stripper *G* in place, while the coil springs shown provide the necessary pressure. Setscrews in the punch holder and the stripper hold the shoulder screws in place. After one slot has been pierced in the cup, the operator turns the work until the locating trigger *H* snaps in that slot, thereby locating the piece for the second slot. The punch is constructed with a heel that enters the die before the piercing takes place, thus providing sufficient rigidity.

Pouring Babbitt-Metal Bearings —Discussion

By A. Hoyt Levy

REFERRING to an article by E. Andrews, under the title given above, and published on page 191, Vol. 65, of the *American Machinist*, I wish to take issue with Mr. Andrews in regard to the use of a propeller for mixing alloys.

Although furnaces equipped with propellers are used to quite an extent in printing plants where type metal is melted for linotype machines, they have never been successful. The reason for their failure is obvious—the propeller does not "mix" the ingredients. It does no more than to whirl them around in the one circular path made by the rotating blades, without appreciably disturbing the various layers of metal. This condition may be verified by melting a formula of lead, tin and antimony. Let it stand for a while and then draw a sample from the bottom and another from the top of the pot. A chemical analysis of each will show that the sample from the bottom carries a higher percentage of lead than that from the top. Now set the propeller in rotation. After sufficient motion, again take samples from the bottom and top, and analyze. While there will, of course, be some improvement, that is, the respective determinations will be closer than in the previous analysis, there will still be too much of a difference between the metal from the top and that from the bottom, for the good of the babbitt.

The only way in which babbitt can be mixed to homogeneity, is by mixing *from the bottom up* and *in all parts of the pot*. The ordinary propeller can not do this. The only device, to the writer's knowledge, which does bring all of the ingredients of babbitt to a homogeneous state by mixing from the bottom up, and in all parts of the pot, is a machine, the patent of which is controlled by a large metal corporation. This machine is placed outside of the pot and can easily be moved from one furnace to another. An adjustable hollow arm terminating in a ladle, extends to the pot. When in operation, the arm moves longitudinally through the molten metal, and at the same time oscillates about a horizontal axis, carrying the ladle to every part of the pot. There are other features of this contrivance by which the temperature of the metal is controlled, or by which the agitation is increased or diminished, according to the character of the babbitt that is being alloyed.

While on the subject of pouring babbitt-metal bearings, it may not be amiss to emphasize the importance of melting the metal to the right temperature for pouring. A temperature of 830 to 910 deg., as suggested by Mr. Andrews may prove satisfactory for babbitts of high copper content, or babbitts containing zinc, such as the alloys known as "white bronze," but for the general utility babbitt in which the tin content is lowest, that range of temperature is entirely too high. The ordinary babbittt should not be melted at a higher point than 600 deg. F. At this temperature, the metal will cast with a dense grain.

As the temperature is increased above this point, the grain becomes coarser, the babbitt becomes more porous, and the tin being more volatile than the lead, oxidizes out in greater proportion than the lead. Every babbitt has a "best" pouring temperature of its own and this heat should be ascertained from the manufacturer of the babbitt. Generally speaking, 600 deg. F. is a good temperature at which to pour lead-based babbitts, and 700 deg. F. is one at which genuine babbitts should be poured. An additional 50 deg. may be allowed for a drop in the heat between the ladling out of the metal and the pouring of the bearing.

Separating Monel Metal Turnings

By means of a magnetic device for separating iron and steel from Monel metal turnings when mixed, the General Electric Co. of Schenectady was able to save approximately $20,000 annually in the disposal of its scrap. Approximately 70 gross tons of mixed metal turnings were scrapped each year, as no method was known of separating the high-value Monel metal from the lower-value iron and steel. Mixed metal turnings were sold for an average price of $15 per gross ton, while clean Monel metal turnings brought approximately $300 per gross ton.

Many methods of separating the two kinds of scrap had been tried without success, including the use of magnetism. The magnetic method was not successful at first, because the Monel metal was also picked up by the magnet. But by using a rheostat on the magnetic separator and by reducing the current to a minimum, a point was reached where the iron and steel were picked up and the Monel metal was dropped. During cold weather a clean separation was difficult because of oil congealing on the turnings and holding the two metals together. One of the plant workmen suggested that the turnings be dried on large steel plates with fires beneath. This procedure was tried and was found to be successful.

It often happens that we can save more money by scrapping an old machine than by firing the old man who runs it. But because we see the payroll every week and don't know what we are losing on the machine, we are too apt to scrap the man first.

THE · FOREMAN'S · ROUND · TABLE

Keeping Men Interested in the Job

The following narrative is a "case" presentation of the topic. It has been written to involve some of the questions that arise in the average shop. For guidance in preparing discussion the questions at the foot of the page have been prepared

"I'VE been reading some stuff about men in the shop, Al, that says we ought to try and give the man an interest in his job. Now, how in blazes can we play nursemaid to a gang of men who don't care for anything but quitting time and payday? I don't get it at all, Al."

"Well, it isn't easy, Ed. But there's something to it just the same. You know how much more you feel like digging in and getting action on a job that interests you. We all do. If it affects us that way, why shouldn't it affect the men?"

"But they don't care a darn, Al!"

"Ed, old boy, it isn't safe to assume that the other fellow is any less human than you are. And it doesn't matter a lot whether he speaks English or comes from Central Europe. We're all pretty much alike down inside. Take your man Tony—don't you think he'd be interested to know that he was working on a machine that was going to the Fiat plant in sunny Italy? Wouldn't he be more likely to take an interest in any job if he knew more about it?"

"I can't see Tony getting interested in anything, Al. All he wants is to get home to Maria and the kids and the garden. You're getting sentimental in your old age."

"Not sentiment, Ed, just plain horse sense. Could you take a lot of interest in making a thousand parts if you didn't know what they were or where they went in a machine? Wouldn't you get a lot more kick out of the work if you knew where the parts went and what they did? You know you would. And I try to pass on as much information as I have of this kind.

"I've asked the 'Big Boss' for a bulletin board, Ed. And just this sort of dope about jobs that come through. Seemed to sort of hit the 'Old Man's' fancy and I guess you'll have one wished on you, too."

"If you've got me into any more work, Al, I'm off you for life. I have trouble enough now."

"It won't make work for you, Ed, except to read the bulletins on the board. But I'll bet you'll be looking for them yourself before long. And I believe you'll find a livelier interest among your men. We are all interested to know where our work goes and how it performs after it gets on the job. I'm hoping they'll post photos of the machines at work in different places. Every man Jack of us would get a kick out of seeing some of our machines installed in India, or China, or Australia. If we don't there's something missing in our makeup."

"Maybe you're right, Al. But I don't seem to enthuse over it as you do," said Ed as they parted company.

Will Al's idea help to interest men in the job? Or is Ed right that they don't care about anything but quitting time and payday? Has the bulletin board plan been tried in your plant and how did it work out?

All foremen are urged to discuss these questions. Acceptable letters will be paid for. The discussion is not limited to foremen, of course

Discussion of Earlier Topics

Getting Information from Catalogs

AL IS right that most advertising booklets contain valuable information for the machine user. Every machine foreman should know each of his machines and their capacities as well as the range and capacity of all other machines on the market for the same work done by his department.

While Ed does not see any value in the machine catalog, it is a safe bet that he reads the catalog and instruction book supplied with his automobile so that he will get the most out of his car and if he had the right qualifications he would read the catalogs and trade journals so that he would have the necessary knowledge to give his employers the maximum efficiency on their machine investment.

If the foreman will write to the manufacturer of any machine that is in his department and send the manufacturer's serial number so that the model and design can be identified, the manufacturer will gladly answer any questions and send any information which will be of help to the foreman. Any machine builder realizes that when new machines are being ordered, the foreman is generally consulted. The manufacturer will want the foreman to have as much faith in the machine as it deserves and to get as much out of the machine as it is possible to obtain, in production.

A foreman of Al's type, on looking through his *American Machinist* each week, would study the advertisements of new machines adapted for work in his department. He would write for further information so that when the superintendent consulted him, he would be posted on any new production equipment. He would then be able to "sell" the new machine to the superintendent.—WILLIAM E. KELVIE, *Engineer.*

Picking Assistants

SINCE Ed failed to start picking his assistant at the proper time—that is, as soon as he got his job as foreman, he must now pick him by elimination.

Let him make a list of those from whom he is expected to make a selection and cross off the names as follows: the men who have never made a mistake; the men who have made the same mistake twice; those who always have ready an airtight alibi when it comes to shouldering a mistake; the men who will never make an independent decision for fear of making a mistake; those who lack patience with other men; and the ones who lack 100 per cent of perseverance.

By this time the lighter stuff will be sifted out and the one to be made assistant can be more readily ascertained. He should best combine knowledge of the best means of accomplishing his chosen work, a hankering after information, and a well grounded feeling of self-respect.

Men who rise in their organizations are the ones who not only know how to prepare themselves, but can select and prepare some one to take their places, assistants who will be a credit to them.—JOHN H. UHRIG.

Letting a Man Try His Own Way

ED SHOULD be the owner of a small one-horse shop where he can follow out his narrow plans and ideas of foremanship handed down from the dark ages when one man ruled and no other dared to even suggest.

Personality brings to the fore such men as Jimmie. They should be given a free hand in a shop on any particular job, without, of course, overlooking the fact that Ed is the foreman. When I say a "free hand," I mean that when Jimmie is given a job to do, if he can prove that by having a tool made that may not be among the tools in the shop he can save the firm money, his suggestion should be adopted and he should be allowed to do the job his own way.

Many foreman are not as broad as they should be and their own conscience tells them that they are supporting their jobs via the bluff method. The "Jimmies" who have ideas get together and compare notes, talk about their jobs, often going into minute details, and cite savings that could have been effected by changed methods if they had been adopted.

The ideal shop foreman should look for all Jimmies and if he can select from the shop men a force of Jimmies, then he is a real foreman and is himself in line for promotion. But if he cannot do this, Jimmie should have his place. Of course, Jimmie may have the brains to understand the possibilities of new methods without having the necessary executive ability to make the good foreman.—H. E. FISHER.

Keeping Machines on the Job

I AM in favor of Al's stand on the maintenance of machinery and feel that the repair man should not be under the foreman. The repair man then will feel that there is a responsibility on him and will do his utmost to keep the machines running.

This man must have a little better than horse sense and realize that in keeping things going he is saving money for the company and also building up a certain amount of pride in himself. He will not vaunt his authority but will be on the job at the proper time.—J. W. CONRAD, *Master Mechanic.*

THE · NEXT · TOPIC

Who Should Keep Machines Oiled?

QUESTIONS

Can "Personal Responsibility" be depended upon to prevent shut downs from bearing trouble?

Is it fair to a piece worker to have him do the oiling and maintenance of his machine?

Is it fair to the machine to have a hurrying piece worker maintain it or is it better policy to have a special oiler do the work?

Ideas from Practical Men

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the metal-working industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

Home-Made, Air-Operated Drill Press for Small Work

BY FRANK WALDO

Bench work in a railway-repair shop usually necessitates the drilling of pin holes in shafts, bars, and other fittings, and, in most cases, a small drill press is provided to handle such work. In our shop, we did not have a machine available and it was necessary to take the work to an adjoining department whenever drilling was required. To avoid the loss of time consumed in taking the work back and forth, the machine shown in Fig. 1 was constructed. Since there was no lineshaft nearby to use for operating the machine, a rotary air-motor drive was utilized. The base of the machine is attached to a bracket located on one of the upright beams next to the bench. To the base is mounted a 1-in. pipe, used for the frame of the press. On the pipe is attached an adjustable table and the spindle supports. Vertical feed of the spindle is hand operated by a lever pivoted to the upper end of the frame as shown. The weight of the spindle is counterbalanced by a coil spring.

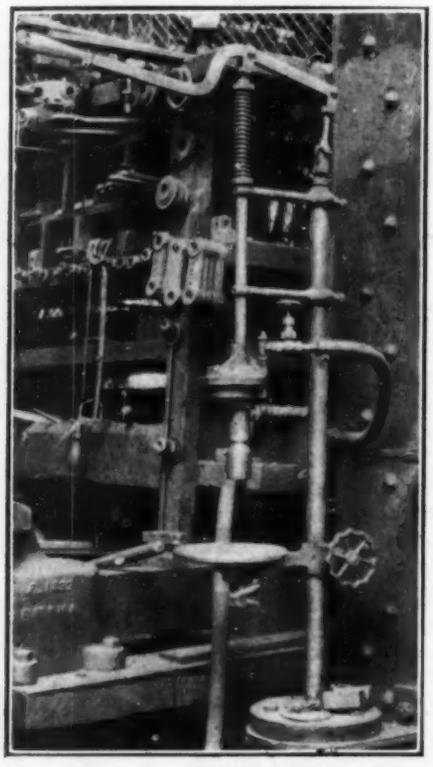


Fig. 1—Home-made air-operated drill press

Constructional details of the air motor are shown in Fig. 2. The body is made of two cast-iron housings, *A* and *B*. The spindle is located off center so that when the rotor *C* is inserted, it will fit the chamber on one side and allow a gap of $\frac{1}{4}$ in. directly opposite. The rotor is made with four slots, $\frac{1}{4}$x1$\frac{1}{8}$ in., into which the blades *D* are assembled so that they can slide radially as the rotor revolves. Air, passed in the inlet *E*, enters the open space of the chamber, and by striking the blades, causes a rotary motion as indicated by the arrows. Centrifugal force keeps the ends of the blades in contact with the body. A $\frac{3}{8}$-in. outlet for the air is provided at *H*. The drawing at the left shows the motor with the bottom section removed, while to the right is shown a cross section through *XXXX*, and a side view of the remaining half.

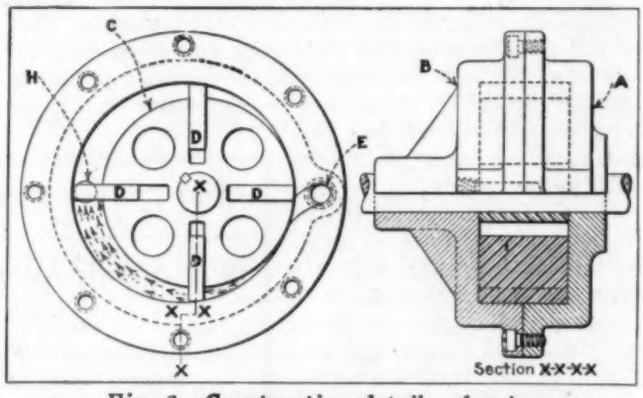


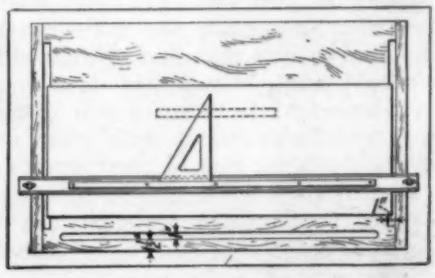
Fig. 2—Construction details of rotor

Drafting-Room Helps

BY J. MCINTYRE
Toronto, Canada

The sketch shows a specially designed top for a drafting table which I believe will be new to many. It has a slot 1 in. wide at each end, running not quite the full width of the table. Long drawings pass through the slots instead of over the ends of the table, thus permitting the free use of the parallel ruler.

A similar slot of the same width is shown near the front of the board, extending to within a few inches of each end. This slot should be on every board where drawings are made of such height as to make it unhandy to reach to the top. The drawings can be drawn down into the slot and still not be creased by the draftsmen leaning against them, as would be the case if they were pulled over the edge of the table.



Improved table top and parallel ruler

Users of parallel rulers have noticed the tendency

for one corner of the triangle to slip under the ruler when drawing a vertical line. This is annoying and requires that a continual pressure be maintained upon the ruler at the point where the base of the triangle rests. Even with care such an accident can happen at an inopportune moment.

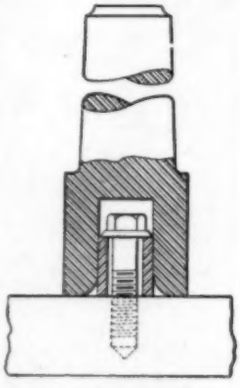
In the sketch is shown an arrangement which makes this condition impossible. A strip of wood is screwed or riveted to the top of the ruler about ½ in. back from the edge and parallel to it. The triangle base rests against the strip on top of the ruler. This arrangement has a secondary advantage and that is that one can work over wet lines, because the base of the triangle is not touching the paper. It would be to advantage, of course, if the other end of the triangle were supported on a ruler, or second triangle, as indicated by the dotted line in the sketch. Horizontal lines can always be worked in over wet ink by slightly raising the parallel ruler while drawing the line.

Tool for Lining Up Buttoned Work

BY CHAS. KUGLER

A tool whereby the time of setting work by the button method can be greatly reduced, is shown in the illustration. When the machine in which the work is to be done is in good condition, an indicator will not be necessary. Otherwise the indicator will be necessary only for the final truing.

As all toolmakers know, the most tedious part of locating a hole by the button method, is bringing the axis of the button in line with that of the spindle. If the tool is made in the machine in which it is to be used, and is always placed in the same position in the spindle, excellent results can be obtained.



Tool for aligning buttons

The button can be approximately aligned with the spindle by the eye, and, if the tool is used in a machine having a vertical spindle, raising the table or lowering the spindle will cause the tool to move the work and bring the axis of the button in line with that of the tool. I always use a ½-in. button, and hold it by a ¼-in. hexagon-head screw.

Many toolmakers know of this method but hesitate to use it for fear of moving the button, but I can assure them that the holding power of a ¼-in. screw is great enough to allow the work to be moved by the button without any slippage.

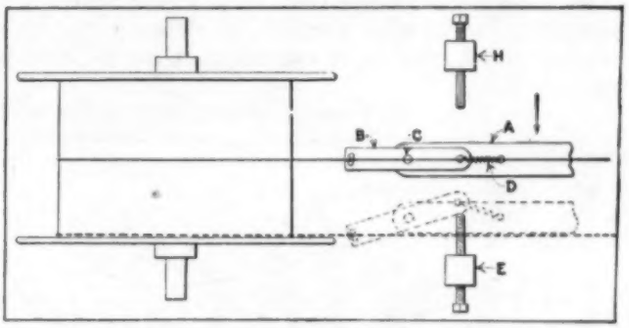
Increasing the Movement of a Screw Feed

BY R. H. KASPER

On a machine used for winding flat wire on reels, the guiding of the wire was accomplished by passing it between two pins on a bar that was passed back and forth across the reel. A double screw with right and left hand thread provided the guiding movement. Since the reels were made of pressed steel and varied somewhat in width, some difficulty was encountered on the narrow reels by the wire piling up on the sides of the flanges, and on the wide reels by a blank space being left on each side.

In order to overcome this difficulty, the following changes were made: A new screw was made somewhat shorter than the narrowest reel. The guide bar *A* was then shortened, and the lever *B* attached, being pivoted on the steel stud *C*. The two guide pins are carried on the outer end of this lever, while a tension spring *D* is attached to the inner end to hold lever *B* central with the guide bar. The two adjustable stops *E* and *H* are attached to a stationary part of the machine.

As the guide bar *A* approaches the end of its travel, the lever *B* comes in contact with the stop *E*, swinging



Alterations made in guiding mechanism

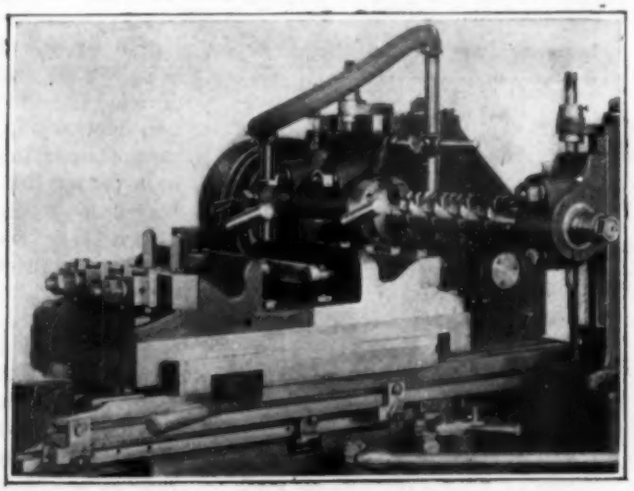
it on its pivot and increasing the guiding action, as shown by the dotted lines in the sketch. The same effect is produced on the other end of the travel by the stop *H*. Though this action slightly increases the space between the laps of wire close to the flanges of the reel, it is piled evenly, and the travel of the guide can be adjusted to suit the individual reel.

Milling Adjusting Nuts for Service Brakes

BY SAMUEL HARMON

For milling the angle on the ends of service-brake nuts, we use the indexing fixture shown in the illustration.

The fixture can be loaded or unloaded at one end while the work at the other end is being operated upon. The fixture is indexed 180 deg. between cuts and holds eight pieces, four at each end. The nuts stand upright in V-grooves in a hardened steel block in which they



Set-up for milling adjusting nuts

are held by clamps, each clamp holding two nuts. The clamps at each end are operated by a single cam and lever.

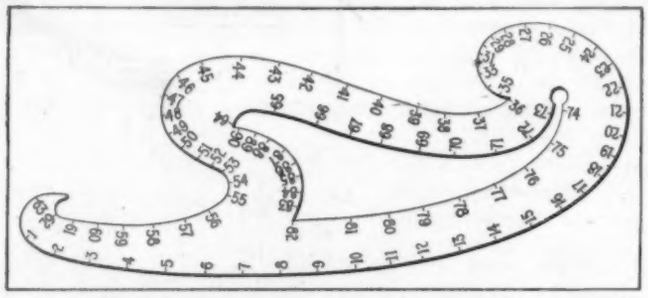
Four 4-in. cutters are used and are run at 66 r.p.m. The feed is 3.87 in. per minute, giving a production of 372 pieces per hr. The work is done in a 24-in. Cincinnati plain automatic milling machine, to the bed of which an extension bracket was fitted to support the overhanging weight of the table and fixture.

An Aid in Inking-In Curves

BY FRANK HARAZIM

By marking reference lines on a French curve and indicating the lines by numbers, as shown in the illustration, the inking in of curved lines can be greatly facilitated.

If, when using the French curve to draw a line with



How the French curve is marked

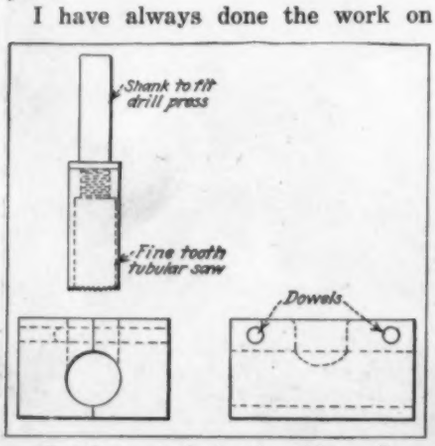
the pencil, a note is made of the numbers of the lines at the beginning and the end of the line, it will be an easy matter to relocate the curve in the same position when inking in the pencil line. By this method the time spent in trying to match the curve with the line will be avoided.

How Would You Do This Job?—Discussion

BY F. L. MCCORMICK

The query by Henry Densmore, under the title given above, and published on page 904, Vol. 63, of the *American Machinist*, and the discussion following it has been of interest to me for the reason that I have been doing a job of this kind at intervals for twenty years.

I have always done the work on a drill press. I machined and doweled together two blocks and, using the parting as a center line, bored a hole lengthwise through them equal in diameter to that of the tube. At a right angle to this hole I bored another the same diameter as the hole to be cut in the tube wall.



Cutting a hole in the side wall of a tube

The cutter is in effect a tubular saw, in which the bore is eccentric in relation to the outer surface. The amount of eccentricity is such that the wall of the cutter at one side is about double the thickness of wall opposite, so that the core, or plug, cut out of the tube is smaller in diameter than the bore of the cutter, and will fall out of the cutter easily. The mean thickness of wall of the cutter should be in proportion to the size of the tube and the thickness of the material of which it is made.

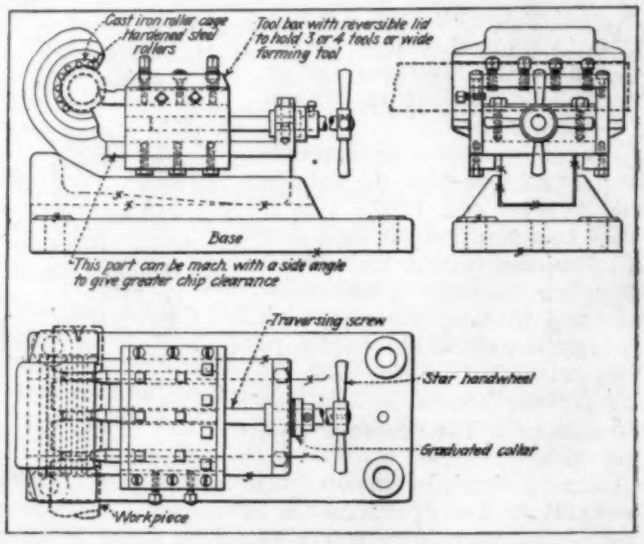
For thin brass or steel tubing, a cutter having a wall thickness of from $\frac{1}{32}$ to $\frac{1}{16}$ in. works very satisfactorily. The side hole can be cut at any desired angle by boring the holes in the jig to correspond. The jig must be arranged, however, so that the hole to guide the cutter will be vertical, if the work is to be done in a drill press. The sketch herewith shows the jig and the cutter.

Form-Turning Thrust Grooves in Shafts

BY R. W. HAGGER

Our product required a large quantity of 4-in. shafts, in each of which three thrust grooves were to be formed turned at one end. When the grooves were cut in an engine lathe, using a single form tool, considerable chattering took place. In order to eliminate the chattering and also to reduce the time of production, the roller backrest shown in the illustration was devised.

The toolblock carries three forming tools, and slides on the elongated part of the backrest. The feed is by the screw and pilot wheel shown. The bottom part of the backrest is a sliding fit in the base immovably at-


Cast iron roller cage
Hardened steel rollers
Tool box with reversible lid to hold 3 or 4 tools or wide forming tool
Base
This part can be mach. with a side angle to give greater chip clearance
Traversing screw
Star handwheel
Graduated collar
Workpiece

Lathe attachment for form grooving

tached to the carriage, and is free to float in any direction except sidewise.

With the shaft supported in line with the tools, and with the backrest and the toolblock floating in unison, the grooves were formed without chatter, and the time per piece was reduced from 1¾ hr. to 17½ min. The device was used in a Gisholt chucking lathe.

Simplification is being extended to army airplanes. It was formerly considered necessary to have fifteen types of planes to meet all military requirements. Now only five types are needed.

Clamps for Jigs and Fixtures

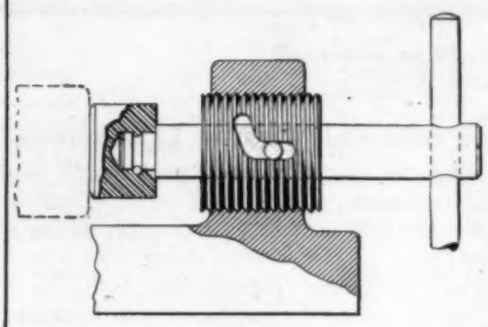


FIG. 1

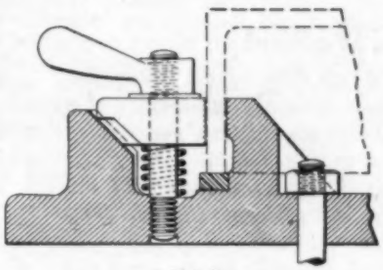


FIG. 2

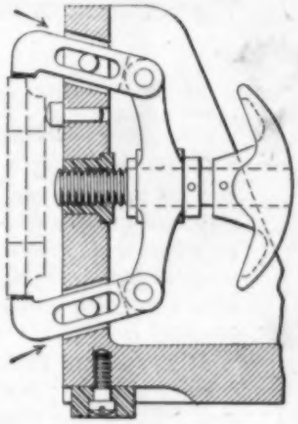


FIG. 3

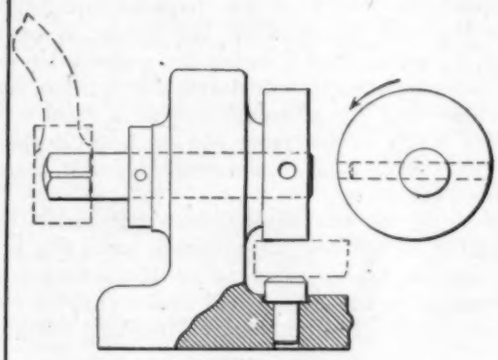


FIG. 4

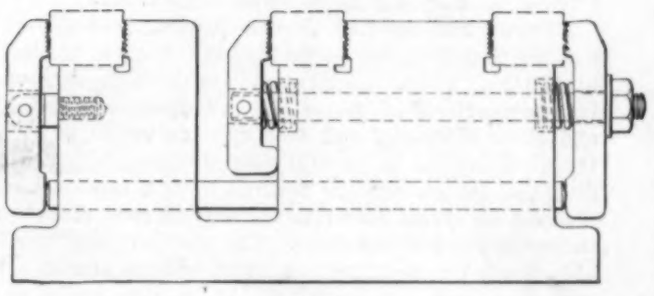


FIG. 5

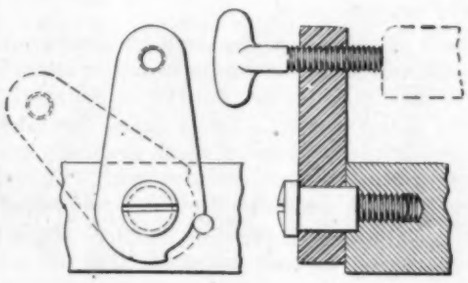


FIG. 6

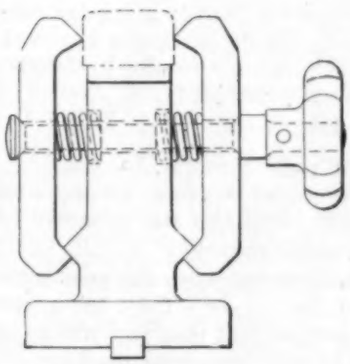


FIG. 7

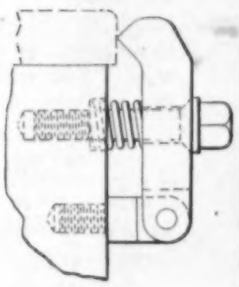


FIG. 8

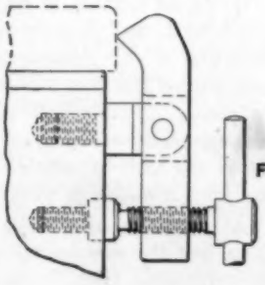


FIG. 9

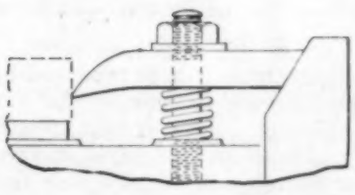


FIG. 10

Fig. 1—Adjustable-cam clamping lever. Fig. 2—Clamps for a thin frame casting. Fig. 3—Centering jaws for round work. Fig. 4—Direct cam lock. Fig. 5—Multiple clamps. Fig. 6—Simple swinging clamp screw. Fig. 7—Double centering clamps. Figs. 8, 9, 10—Screw and lever clamps

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Practical Shop Problems

Questions of a Practical Nature will be answered in these columns

Selecting a Die Steel

Q. We make up a good many dies of all kinds for general punch press work, and have always employed a standard quality of tool and die steel. Can you advise us whether it would pay us to use special steels, and what benefits would be derived from the change? We have read about these steels and understand that they are used for drop-forging dies.

A. If you are using a standard mark of die steel the chances are that you are already using a special alloy steel. For a long time the steel makers have been giving close attention to developing steels that are especially fitted for use in making dies and other tools.

If you have not had the results that you expect, it may be that it is due to the use of one class of steel to fit all jobs. These special steels are made up with varying proportions of tungsten, vanadium, molybdenum, and other elements, and each type or brand is usually featured for one or several special uses. A punch and die steel, for example, is distinct from a tap steel.

Don't be afraid to write to the tool steel makers for their descriptive literature. The circulars and booklets gotten out by these companies constitute almost a liberal education on the subject. By getting copies of all of this literature you can readily decide what steels you will choose for each kind of tool or die job. It is very important, however, to follow the heat-treating instructions given by each company for its particular brand of steel. You will not get satisfactory results by following one general hardening rule for all types.

Size of Motor for a Shaper

Q. We have recently acquired a 24-in. shaper, and have a 3-hp. motor in stock. Will this size of motor be large enough as a drive for the shaper?

A. The size of motor will depend upon the gear ratio and the work to be done in the shaper. The 3-hp. motor may do as a makeshift, but we feel that you will need a 5-hp. motor to get full benefit from your machine.

Electrolytic Iron

Q. What is electrolytic iron, and for what is it used?

A. Electrolytic iron is produced by the deposition of iron by the electric current in a manner similar to electro-plating. Bars of cast iron are used as anodes and dissolve in an electrolyte of ferrous chloride. The current deposits chemically pure iron on the cathodes, which are hollow steel cylinders. On each cathode a seamless tube of iron is built up by the electric current. The iron tube is removed from the cathode by hydraulic pressure. The tube is annealed and rolled into plates of any desired size. Electrolytic iron can be produced 99.96 per cent chemically pure, but it is expensive, and is only employed commercially for magnetic cores.

Permissible Load on Lead Screws

Q. What is the maximum permissible load on a 29-deg. lead screw with bronze nut? That is to say, what are the relations between length, diameter, pitch and load?

A. The maximum permissible load on a lead screw can be found by means of the formula: $L = \frac{\pi n}{4}(a^2 - b^2)S$, in which n equals the number of threads in contact, or length of nut measured in threads; b equals the root diameter of the screw; a equals the outside diameter; and S equals the permissible pressure per square inch of protected area for a given material. The value of S for a bronze nut on a steel screw for a power screw varies from 800 to 1,400 lb. per sq.in. The lower values of S are employed for the higher speeds of the screw.

The angle of the thread does not enter into the calculation of the bearing pressure since the projected area only is taken. Regarding the location of this information in books, you will find a chapter on screw threads in any good textbook on machine design.

Designations of Low Carbon Steels

Q. Please tell me the difference between cold-rolled steel and machine steel.

A. Both of these classifications for steel are indefinite and should not be used alone for ordering material unless no particular qualities are desired in the steel. Almost any kind of low-carbon steel is called machine steel or soft steel, while cold-rolled steel generally means any low-carbon steel that is finished cold. The chief distinction between machine steel and cold-rolled steel is that the latter has a smooth, polished surface and is furnished to more nearly accurate sizes.

Etching Testing Balls

Q. In an article on page 517, Vol. 65, of the American Machinist, *and also in a paper read before the Chicago meeting of the American Society for Steel Treating, it was stated that an etched ball gives a clearer impression in using the Brinell method of hardness testing. I always understood that etching produces a rough surface. Is this desirable on the ball? Also, please tell me why a solution of nitric acid in alcohol is used.*

A. Etching of the ball does produce a rougher surface, but the very weak etching solution used gives only a roughness that is hardly perceptible. The slightly roughened surface of the etched ball will take hold better, while the perfectly smooth surface has a tendency to squeeze out.

Not more than 2 per cent of nitric acid is used in the etching solution. Alcohol is used for diluting the acid instead of water in order to prevent corrosion of the ball.

Technical Abstracts

Belt Dressings

There are two classes of belt dressing, the lubricating and the anti-slip. The first renews the internal lubricant in the belt, while the second temporarily gives the belt a better grip on the pulley and is usually harmful. Of the first, the paste dressing is most convenient. A very satisfactory paste can be made by mixing equal parts of beef tallow and cod-liver oil while warm. The mixture cools to a paste and is applied with a swab. It has a tendency to separate after long standing and must then be remixed.

Neatsfoot oil is a good dressing, if used with care; too much oil makes the belt soggy and slippery. A somewhat better medium to employ is castor oil. A properly dressed belt is supple, but not greasy.

Mineral oil will slowly rot a belt and it should be removed before the dressing is applied. French chalk can be used for the purpose, if the belt is not too oily. The chalk should be spread on the surface of the belt and left to stand until the oil is absorbed. The chalk is then scraped off. Gasoline can be used on a rag, or in extreme cases, the belt can be immersed in gasoline.—*The Automobile Engineer*, September, 1926, p. 337.

Installment Selling

The basic meaning of the recent growth of installment selling is that in a period of increasing productivity industry turns out more goods than consumers can buy with their incomes. According to W. T. Foster of the Pollak Foundation, there is always a piling up of stock that cannot be sold for cash without a fall of prices during every period of business expansion.

This condition arises from two causes: First, because industry does not disburse to consumers as wages enough money to buy its products; second, because consumers under the necessity of saving do not spend even as much as they receive. Since consumers, then, cannot buy the goods with current income, industry has resorted to installment selling by which much of the purchase price comes from future income.

During 1925 about $3,000,000,000, or 7½ per cent of total sales to consumers, is represented by the unpaid portion of goods bought on installment. Most of these goods would not have been sold at all had the buyers been required to pay cash for them. In that case the goods would not have been produced at all.

The growth of installment selling has saved the country from a marked business depression, but installment selling cannot permanently produce prosperity. For business as a whole, installment sales of today are made partly at the expense of sales at some future date. But the principle behind installment selling is right, that something should be done to enable the people, as consumers, to acquire and enjoy whatever they, as producers, can produce.—K. W. Stillman, in *Automotive Industries*, Sept. 23, p. 494.

Employee Stock Ownership

The progress of employee stock ownership in the industries employing labor is at present reaching the proportions of a general movement. Today wage earners own $1,000,000,000 worth of stocks in companies for which they work. This includes $700,000,000 worth in companies which are helping employees to finance their purchases, and another $300,000,000 purchased informally by employees.

Actual stock ownership is taking the place of many profit-sharing plans, once important factors in the labor movement. Profit sharing was granted usually through the generosity of the owner, and the employee assumed no responsibility in profits and losses. But the aim of stock ownership is that the employee shall become a capitalist on a small scale and share in the profits or losses proportionately to his holdings of stock.

Some companies have sold to employees an issue of stock especially created for them. This stock is preferred, but is non-voting. Individual workmen have built up for themselves a comfortable secondary income by taking advantage of the company's stock offers. The case is given of a blacksmith who left $70,000 in stock at his death, although he remained a blacksmith to the end. Stock ownership has proven far more beneficial to employees than any known plan of profit sharing. It has also promoted better relations between the management and the employee, and the latter does his work more efficiently and is more interested in the business.—Roy Dickinson, in *Printers' Ink*, Sept. 23, p. 73.

Mobile X-Ray Equipment

Because of the extremely high voltage employed and the injurious effects of X-rays, means must be taken to protect operators and workmen in the vicinity of an installation for examining castings. At the Watertown Arsenal the installation is inclosed in a lead-lined room which confines the rays and is carefully grounded to avoid danger from the high potential. At the Bureau of Standards the tubes and power plant are in a lead-lined room and objects to be examined are set up outside windows that permit the rays to get at them. They are protected by lead shields to stop scattered rays. Lead ¼ in. thick is ample.

Another system provides a lead-covered drum or box for the tube. Screens inclose the power plant and high-tension connections. Such an outfit can be made mobile which permits it to be disconnected and re-assembled in another locality very quickly. It also permits of the employment of cranes for handling heavy pieces. It is far less expensive than the lead-lined room and also makes fluoroscopic examination feasible.—Dr. Ancel St. John in *Iron Age*, Sept. 15, p. 783.

Rotary Carburizing

The rotary carburizing method lends itself very readily to taking progress samples. The end plug of the retort is quickly removed, the sample hooked out and quenched, and the plug replaced. With pot-packed work a clay seal usually has to be broken and the work fished for blindly; with danger of disturbing the other work and consequent spoilage. If, on sampling, it is found that the case depth is correct and a longer exposure would be a disadvantage, the parts may be dumped immediately and further carburization stopped on every part of the charge.

If, when doing deep-depth carburizing, it is found that the rate of penetration is slower than expected, or if the nature of the work is such as to grind up or exhaust the carburizing material to too great an extent, more carburizing material can be added at any time.—Stanley P. Rockwell in September *Machinery*, p. 12.

Nut Dimensions

Experience indicates that the limiting factor in the outside dimensions of a nut is its ability to transmit torque, rather than its strength. Nuts have been sawed more than halfway through and tightened under various conditions without failure. The results showed that no steel nut in use today is so light that there is a question of strength of side wall.

A nut, the thickness of which is 87½ per cent of the bolt diameter, is usually satisfactory, and for many uses a thickness of 75 per cent suffices as far as the strength of the thread is concerned. There should be enough excess capacity in the thread and at the nut corners, however, so that the bolt will break before either of these parts of the nut fail.

The torque-transmitting ability of a nut depends upon its fit in the wrench, its hardness, and its size. Hence when nuts are selected, the hardness and workmanship on both the nut and wrench must be considered in addition to the outside dimensions, and much smaller sizes than the U. S. standard can be used with hardened nuts and reasonable tolerances.—Geo. S. Case in *Mechanical Engineering*, September 1926, p. 919.

American Machinist

KENNETH H. CONDIT AND FRED H. COLVIN
Editors

Established 1877

American Shops as Seen by British Workmen

SOME time has passed since the visit to the United States of the delegation of British workmen sent by a London newspaper and the interest aroused then has died down. Their findings, as recently summarized by the U. S. Department of Labor, are still a live subject for American shop executives to consider. For there are many shops in the United States in which the practice is not so modern as that in some of the shops visited by the British delegates.

Some of the important points brought out in the summary are these:

The care taken by the management to see that the men are able to devote full time to production. Waits for material or tools are eliminated or reduced to a minimum. All kinds of labor-saving equipment is provided to save human energy for the main purpose.

The extent to which electric power is used.

The excellent relations between employer and employee. It seems to astonish the visitors that an employer is even willing, let alone eager, to have the men in his plant forge ahead and make money. Here, apparently, is the fundamental difference between European and American industry.

High wages as an employer's policy. Europe, it seems, is not convinced that the recently advertised American policy of maintaining high wages to insure the continuance of prosperity is a sound one. This attitude is not at all surprising in view of the fact that so many American employers find it hard to break away from the old low-wage tradition.

The average American employer will do well to study the summary of the British delegate's views. Just because his shop happens to be situated in the United States is no guaranty that it is managed as well as the shops visited. Through alien eyes he can see which factors are considered to be the ones responsible for American progress. He can then study his own methods to discover how nearly they conform.

Take a Tip from the Doctor

MANY a builder of industrial machinery, no matter how keen a business man he may consider himself to be, could take a tip in business methods from the medical profession. The doctor collects his fee whether the patient lives or dies unless, of course, he chooses to take the case as a charity one. He does the best he can but he makes no guaranties that his work will be successful.

But what of the machinery builder? He prescribes for a production ailment of his customer a piece of equipment that has cost the builder a lot of money, effort and time. And he guarantees that it will do a certain job. If it fails, by even a small amount, he takes it back when the customer insists and pockets the loss.

Perhaps it is hardly logical to compare professional methods with business methods but it sometimes leads to healthy exercise of the gray matter to do so.

A Sign of the Times

AVIATION is becoming commonplace, a condition that will appeal strongly to those who want to do business on a commercial basis. The latest evidence of this trend is the War Department announcement that commercial flying machines will be "garaged" and serviced at Army air stations when necessary. Commanding officers of these stations are authorized to sell supplies at the local rates for their respective communities and to furnish shelter at a dollar a night for single-engine planes and three dollars for multi-engine craft. Where emergency repairs are needed to enable a ship to reach the nearest privately operated airport, the Army charges $1.25 an hour for labor, unless the going local rate is different from that figure, in which case it will be the basis of the charge.

There could hardly be a better indication of the fact that commercial aviation is established, for the Army does not make provisions such as these unless there is a real need.

Square Dealing Is Infectious

THE extent to which the attitude of the head of a company will spread down through the ranks of employees is remarkable. If the man at the top is absolutely fair and honorable with his employees, the chances are that they will be equally honest with him and with each other. If it is generally understood throughout the organization that the company stands for absolutely fair treatment of customers, and practices what it preaches, the salesman, the demonstrator, the service man or any other employee is likely to adopt the same attitude. Unfortunately, the converse is equally true. Instances of both types of organization are easy to find.

Shop Equipment News

Chambersburg Double-Frame Steam Hammer, Type B

The Chambersburg Engineering Co., Chambersburg, Pa., announces a series of Type B double-frame steam hammers ranging in size from 600 to 24,000 lb. The 5,000-lb. hammer is illustrated.

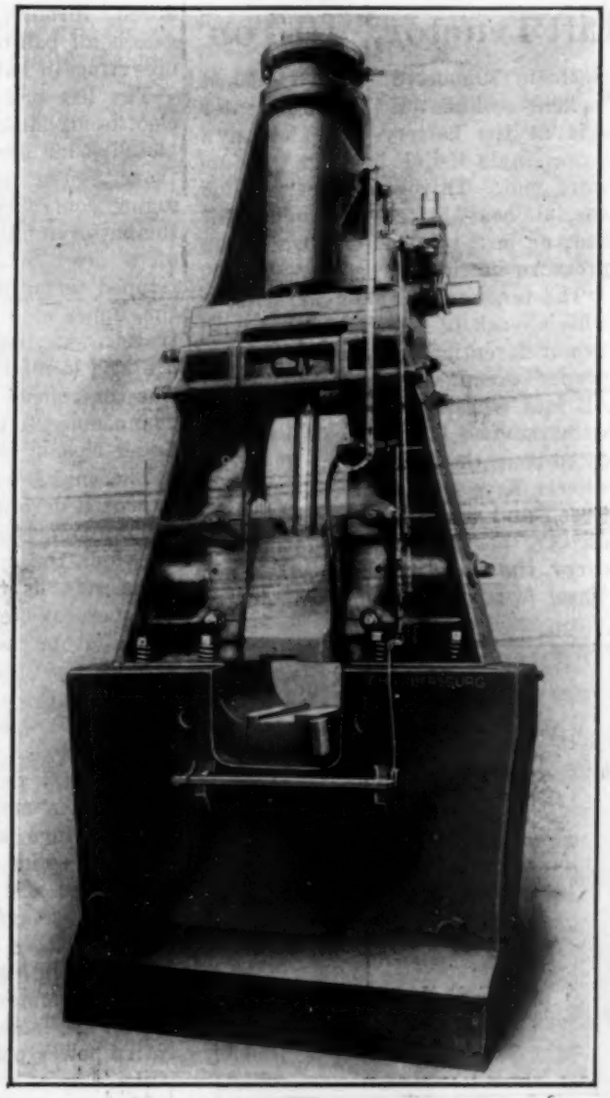
The anvil is solid and cores have been avoided except at the side for handling purposes. The side frames have been designed so that their bases are on a line with the die-line instead of with the sow block. With this construction, it is said that any rocking tendency is eliminated. No square corners are exposed on the frame seat or the anvil. The sow block is set well within the anvil to assure rigidity.

The tie plate locks with the side frames to prevent movement either out or in, and a tongue and groove is used to maintain alignment in other directions. The cylinder-block base is also locked to the tie plate in order to maintain alignment in case the plate should wear due to weavage. The four tie bars have been lowered to give greater strength.

A safety cylinder head is placed on top of the cylinder. It contains a piston of a slightly greater diameter than the ram piston and is connected direct to the live steam line, so that a cushion is formed. The usual bumper springs and safety pin in the ram are omitted.

The guides for the hammer are supported by the frame in planed pockets and adjustment is provided by a steel taper shoe bearing full length and width against the guide. The ram is an open-hearth steel forging. A one-piece cam actuated by the ram provides for automatic operation as long as the operator's foot is on the treadle.

Through bolts are used whenever possible, and all studs have been eliminated except in the gland and on the cylinder head of the machine.



Chambersburg Double-Frame Steam Hammer Model B

The specifications for the 5,000-lb. machine are as follows:

Bore, in.	17
Stroke, in.	50
Distance between ram guides, in.	27½
Depth of ram, in.	30
Steam pipe line, in.	4
Exhaust pipe line, in.	5
Steam pressure, lb. per sq.in.	100-125
Weight of machine, lb.	145,000

Kelly Driving-Box and Car-Wheel Boring Tools

The Kelly Reamer Co., Cleveland, Ohio, is marketing the driving-box and car-wheel boring tools illustrated in Figs. 1 and 2 respectively. The tools are of the block unit type, and it is possible to bore a complete range of sizes with one bar and with the different block units. The support bar is placed in the machine, properly aligned, then keyed into position. Different sizes of block units can be quickly interchanged in the bar for different size bores. When it is desired to bore larger sizes, a support head is slipped upon the bar, and it supports the block unit close to the cutting point to insure rigidity.

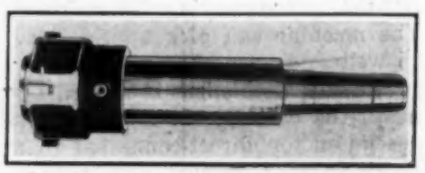


Fig. 1—Kelly Driving-Box Boring Tool

The block units are heavily constructed to withstand the loads and shocks to which they are subjected. The blades are made of special-analysis high-speed steel of ample cross-section so as to provide sufficient cutting face and enough metal to dissipate the heat of the cut. The blades are adjusted in or out by means of a rack that engages a pinion. This pinion is integral with a worm wheel that in turn engages a worm. Three blades are used, and each is driven by the same worm, so that the blades can be adjusted simultaneously. Each blade is provided with an individual lock.

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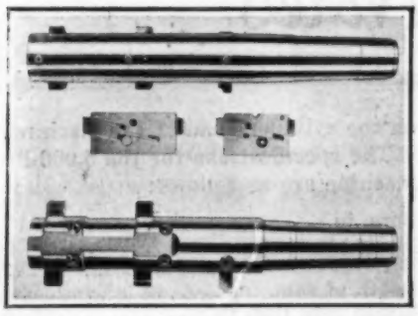


Fig. 2—Adjustable Block Unit and Car-Wheel Boring Tools

The holding bars are made of heat-treated alloy steel, while the support heads are made of ribbed steel castings to provide lightness and strength.

The driving-box boring tool shown in Fig. 1 is a three-bladed tool. The bar is 6¾ in. in diam. and the tool is designed to bore driving boxes ranging from 8 to 14 in. in diam. When the tool is used with a standard support head, diameters up to 30 in. can be bored. The open bar bores holes from 8 to 11½ in. in diam. Bores up to 14 in. in diam. can be obtained by use of the support head No. 1 RSH.

The adjustable block unit car-wheel boring tools shown in Fig. 2 are made in two sizes. No. 1 will bore holes ranging from 5½ to 7½ in. in diam., while bar No. 2 will bore holes ranging from 7 to 9 in. in diam. The boring bar is 4½ in. in diam. The blades are ¾x1½ in. in cross-section and are simple in design so that they may be replaced readily.

Elwell-Parker "Super-Lift Tructor," 10-Ton

The Elwell-Parker Electric Co., Cleveland, Ohio, is marketing the 10-ton "Super-Lift Tructor" shown in the accompanying illustration. The machine can pick up this load as well as transport it electrically.

The lift mechanism is located beneath the battery. It consists of a special motor direct-connected to a single-worm reduction unit with a nut built into the hub of the worm-wheel. A forged multi-thread worm or screw-lift ram travels in and out of this nut, simultaneously lifting or lowering the load. The lift ram is a one-piece forging designed on the same principle as those used on the 2- and 3-ton type EG lift truck made by this company. The ram raises and lowers an all-steel re-enforced platform supported by two bushed rockers or links on the main center sills at the battery end and on a large single H-link beneath the forward end. This link is carried on special heat-treated bushings that bear on heat-treated pins, which are pressure lubricated.

The tandem trail axle carries four wheels, each of which is fitted with two differentiating tires to provide proper creep when being steered. All four wheels steer simultaneously with the two large drive wheels located beneath the battery. The four wheels have 13x8½-in. solid rubber tires, and since they are located directly beneath the platform they carry the bulk of the load. Each wheel is mounted upon two tapered roller bearings carried on independent drop-forged hubs that rotate on heat-treated alloy steel knuckle pins. These knuckle pins are cupped at the lower end and carry a steel ball that contacts with a hardened steel button reposing in the yoke. This method of support is said to result in easy steering.

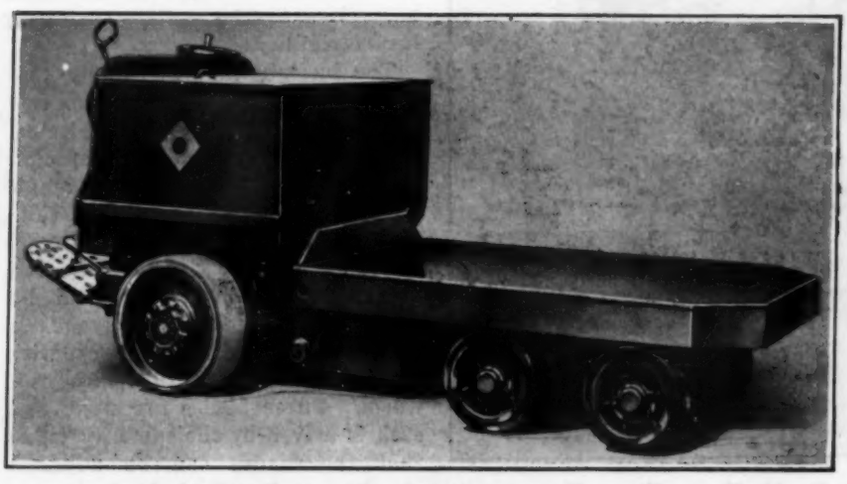
The steering levers at the trail axle are all made of vanadium steel. All swivels are of the ball and socket type. The steering rods from both axles terminate at the foot of the steering post, which is designed with tapered serrations to receive special drop forged ball levers. The levers are retained in position by lock nuts. The lower end of the steering column rotates in a ball bearing. Steering is accomplished by means of a hand-wheel, the motion of which is reduced through mitre and worm gears, all ball-bearing mounted and operating in baths of oil.

The lift motor is fitted with an electro-mechanical brake. The complete lift mechanism may be removed from the tructor as a unit. The lift motor controller is located beneath the battery and is operated by means of a lever which is automatically tripped when the platform reaches the upper and lower limits of its travel. Automatic trip connections are also located beneath the battery. The controllers are fitted with interchangeable fingers and reversible finger tips.

The main travel controller is of improved design. The reverse drum is interconnected with the lift pedal on which the operator stands. This drum returns to off position when the operator steps down, as does the main drum when the controller handle is released. The other pedal automatically applies the brake as soon as the operator's weight is off the tructor.

The main drive unit consists of disk wheels mounted on double-row ball bearings and carrying special 22x6-in. solid rubber tires. The three-point axle carries the frame on dual coil springs. The axle ways are self lubricating and are fitted with renewable linings. All moving parts from the motor shaft to the drive wheels are made of alloy steel. The entire power plant is removable as a unit.

The frame is of heavy construction, but it has been designed to



Elwell-Parker "Super-Lift Tructor," 10-Ton

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keep the weight down to a minimum. The machine weighs complete with battery approximately 6,100 lb., and it carries 20,000 lb. at a rate of 300 to 400 ft. per minute.

Porter-Cable Disk Grinder Type D-3

The Porter-Cable Machine Co., Syracuse, N. Y., has placed on the market the 15-in. horizontal disk grinder shown in the accompanying illustration. It is claimed that this machine is the only motor-driven horizontal disk grinder of its size, and is particularly useful for burring small parts after milling, stamping, or turning. The machine is also used for removing surplus metal on fitting operations in the assembling department.

The Type D-3 disk grinder is claimed to be simple to operate, and

Porter-Cable Disk Grinder, Type D-3

it can be employed on production work with girls or inexperienced help. The operator sits beside the machine resting his arm in the guard plate, and needs only to move him hand through a short arc. The speed of the operation is limited only by the speed of the operator.

The vacuum dust remover provided on the machine consists of fins cast into the back of the metal disk. The revolutions of the disk produce a vacuum in the outlets that sucks in the dust and delivers it through the exhaust hose. For work requiring more than half of the disk the guard plate is removed and the auxiliary guard is swung to one side.

The type D-3 machine does not require bolting to the floor, and may be moved to any part of the shop in order to save trucking of the parts. The center of gravity of the machine is directly above the supporting members and thus insures stability. The motor is operated by connecting it to any lamp socket.

The frame, base, pedestal, and housing of the machine are of cast iron of great enough proportions to insure rigidity and strength. The 15-in. disk is 40 in. from the floor, and the machine can be built into a work bench for convenience of production. The over-all dimensions of the machine are 20 in. by 22 in. The motor provided is rated at ½ hp. at a speed of 1,725 r.p.m. Two disks are furnished with the machine for convenience in changing the abrasive.

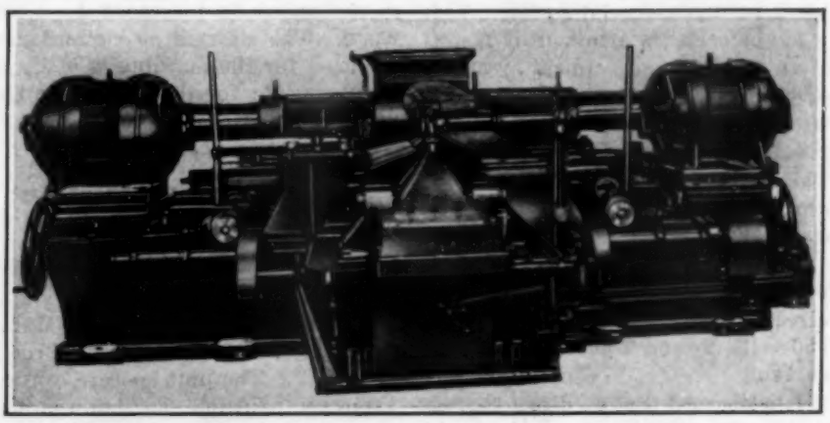
Badger Double-Spindle Grinder, No. 224, With Oilgear Table Feed

The Badger Tool Co., Beloit, Wis., has added an Oilgear table feed to its No. 224 double-spindle grinder shown in the accompanying illustration. The mechanical feed machine was described on page 38, Vol. 63, of the *American Machinist*.

As regularly furnished, the table makes 4 cycles per minute. It moves in to grind, back to the outside edge of the wheels, in to center to regrind, and all the way out to eject the piece automatically. A new piece is then inserted by the operator. The cycle can be varied by changing the cam operating the Oilgear valves to obtain strokes ranging up to 20 in. When changes in the gear train are made, 20 cycles per min. can be obtained.

The Oilgear pump is driven through a motor by means of a Whitney chain drive. The same motor also operates the cam gears through suitable shafting. The valve operated by the cam controls the cylinder valves so that they immediately change in direction. A supplementary valve operated by a stop on the table idles the machine a moment in order to give the operator time to insert a new piece in the fixture. The supplementary valve is operated in conjunction with the main cam control valve, and also by the idling stop on the machine, so that double valve control is obtained. A safety valve stops the machine in case a piece is inserted crooked and breakage is prevented. With the gear-driven table, either the gears or the piece gave away when jamming took place. A lever is provided on the left of the table to operate a by-pass to stop the table reciprocation altogether.

Coolant is supplied to the wheel through a Fulflo water pump driven from a pulley on the Oilgear pump shaft. A wheel dresser is provided



Badger Double-Spindle Grinder, No. 224, with Oilgear Table Feed

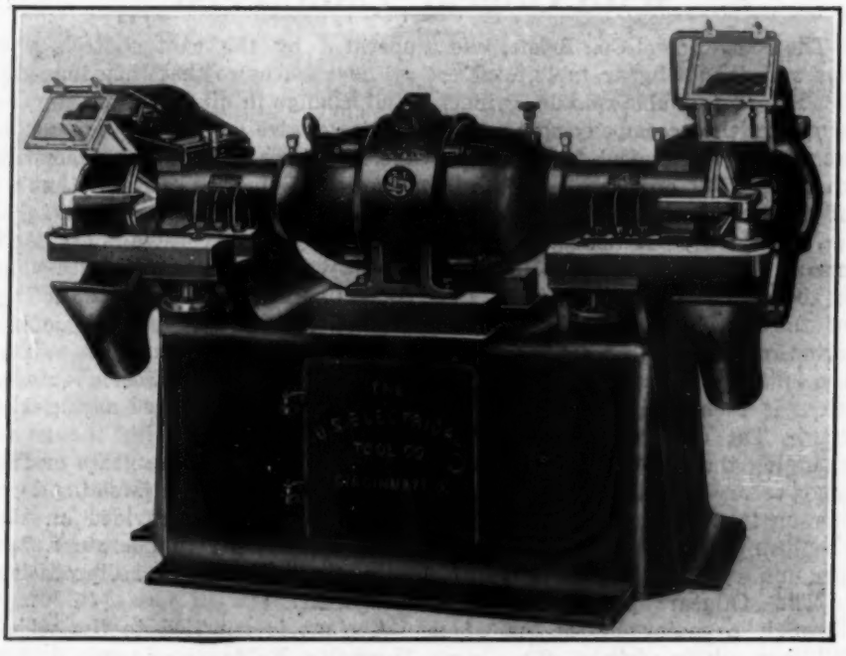
Shop Equipment News

on the back of the machine. It is mounted on A-swing-arms and is advanced forward between the wheels.

Either 24-in. diam. disk wheels or 30-in. disk wheels may be used. The spindles are connected to standard 20-hp. motors through sliding couplings, as in previous models. All other parts of the machine are standard.

"United States" Adjustable-Speed Grinder, Heavy Duty

The heavy-duty ball-bearing adjustable-speed grinder shown in the accompanying illustration has been brought out by the United States Electrical Tool Co., Cincinnati, Ohio. The grinder has the same general specifications as the other heavy-duty grinders of the company, but in addition it is designed for a constant peripheral speed of the wheel regardless of the wheel diameter. This constant speed is attained by means of an automatic adjustment by means of which the motor speed is regulated when the adjustment of the guards are made for wheel wear. This type of grinder is claimed to be economical because of its automatic speed adjustment.



"United States" Heavy-Duty Adjustable-Speed Grinder

The adjustable-speed grinder is made for both 110 and 220 volts, direct current, and for 220, 440 and 550 volts, 2- and 3-phase alternating current.

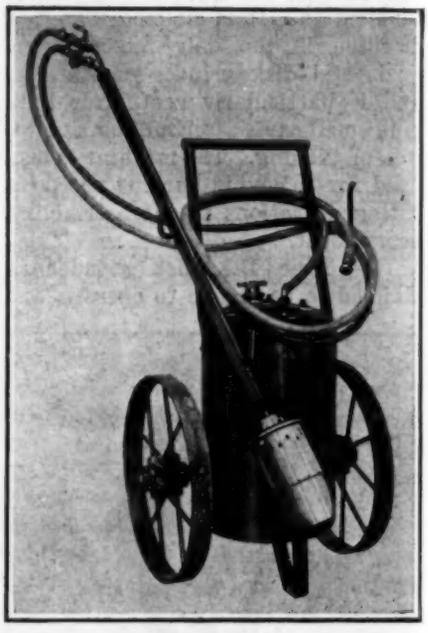
It is claimed that on direct current a constant peripheral speed can be obtained regardless of the wheel size. On alternating current, starting with a 24-in. wheel at 900 r.p.m., which gives a peripheral speed of about 5,500 ft. per min., the wheel can be used until it is worn to 18 in., at which point the next speed of 1,200 r.p.m. will be brought in by moving the hand lever. Another change in speed is obtained when the wheel is worn to 12 in., at which point the motor speed is increased to 1,800 r.p.m. The alternating current motor used for the machine is of three speeds, while for direct current the regular multi-speed motor is used.

Hauck Venturi Suction Torch

The venturi suction torch shown in the accompanying illustration is being marketed by the Hauck Manufacturing Co., 126 Tenth St., Brooklyn, N. Y. The unit operates on the aspirator principle, so that there is no pressure on the oil in the tank or in the hose at any time. As soon as the suction ceases, the oil flow stops simultaneously. In case either the air line or the oil line should be cut, the flow of oil stops.

The outfit consists of the torch, an oil tank mounted upon wheels, and oil and air lines. The air hose is for connection to an outside source of air pressure.

The burner is made of sheet steel and pipe while the nozzle is made of cast iron. The burner unit is light in weight and has a comfortable handle or grip. It can be readily dismantled for cleaning. The materials have been selected to insure long life and durability of the burner. The oil and air hose are made of special composition rubber to withstand the oil and high air pressure respectively that they are subjected to. The oil tank is made of seamless drawn pressed steel. The bottom is interlapped and brazed, and all fitting connections are welded. The tank is equipped with a double wire gauze screen in the filler connection to prevent ignition of oil or gases in the tank. A ball check in the filler cap seals the tank when it is tilted or upset.



Hauck Venturi Suction Torch

The torch operates on fuel oil as heavy as 28 deg. Baumé and on all lighter oils and distillates. The usual air pressure ranging from 50 to 100 lb. per sq.in. is required. To light the burner, ignited waste or paper is held underneath the nozzle while the air cock is opened gradu-

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ally. When the proper mixture of air and oil is obtained, ignition takes place. Preheating or warming is unnecessary. It is claimed that the flame burns steadily without pulsations. The flame range is wide and the size of it can be controlled by manipulation of the air cock. The torch can be operated 14 ft. above the level of the tank.

The burner, hose and oil syphon tube can be applied to a standard type of pressure oil burner, thus changing it into a suction type.

Clark Caster-Wheel Trailer with Automatic Hitch

The Clark Tructractor Co., 1102 Days Ave., Buchanan, Mich., has placed on the market the caster-wheel trailer with automatic hitch shown in Fig. 1. The caster-wheel trailer is claimed to be most economical for the carrying of heavy and bulky materials, and the design permits the trailers to follow perfectly when a number of them are coupled together and to turn within a small radius.

The platform size on the trailer is 6 ft. long by 3 ft. wide, and it is 13½ in. from the ground. The platform is made of cross boards of hardwood held in place by hardened bevel sills and reinforced by steel plates. The main frame is of 3 x 2½-in. T-irons, one continuous piece encircling the platform with the ends welded together. The strengthening girders run lengthwise under the platform for additional support.

The rear axle is supported on heavy steel brackets reinforced by two additional supports on the longitudinal girders. The rear wheels are 12 in. in diameter with a 3½-in. face. The front wheels are of the caster type, 10 in. in diameter with a 3-in. face. The wheels are of cast steel, and are equipped with Hyatt heavy-duty roller bearings. Lubrication is by high pressure Alemite lubricating nipples. The wheelbase measures 38 in., and the wheel gage is 23 in.

The automatic hitch, illustrated in Fig. 2, is designed to insure rapid coupling and uncoupling of long strings of trailers. The hitch is also claimed to permit trailer trains to turn sharp corners without unnecessary drag. The driver may couple or uncouple a trailer without dismounting from the tractor.

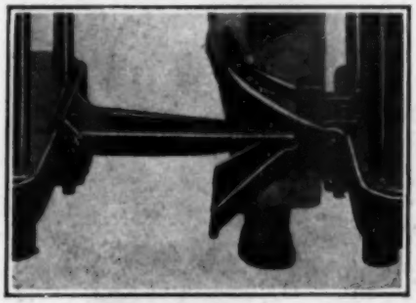

Fig. 2—Automatic hitch

Racks for holding materials on the platform may be used on either the sides or ends. Eight steel pockets are bolted to the underside of the platform for holding in place the rack rails. The rails are of 1-in. pipe, all joints being welded together. The racks are 35 in. high and 24½ in. wide, and are interchangeable for either ends or sides of the platform. The weight of the trailer is 500 lbs. and the carrying capacity is 4,000 pounds.

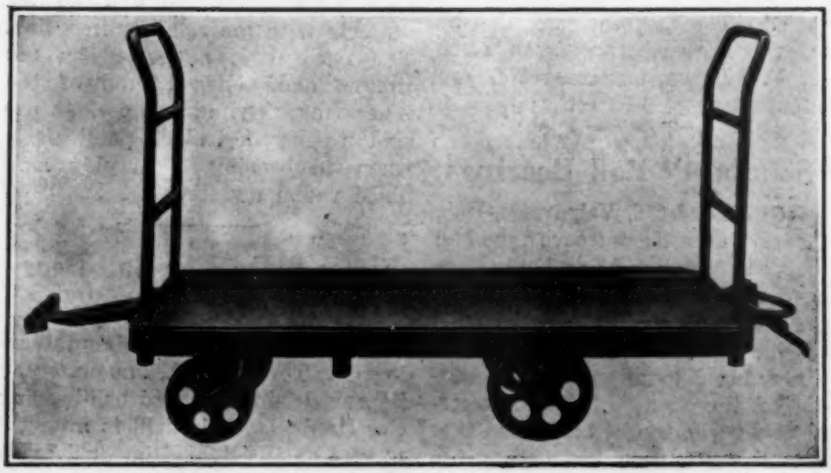

Fig. 1 — Clark Caster-Wheel Trailer with Automatic Hitch

General Electric Melting Pot, 1,000-Lb.

The General Electric Co., Schenectady, N. Y., has added a 1,000-lb. metal melting pot to its line. This pot, which utilizes the electric heating principle, is essentially the same as other standard General Electric melting pots except that three cast-in, sheath-wire, immersion-heating units are used instead of two.

Each heating unit is rated at 5 kw. The pot may be operated either on 110- or 200-volt, a.c. or d.c. circuits. The use of three heating units permits the units to be operated on three-phase systems also.

The pot consists of a sheet-steel cylindrical casing, in which is supported a cast-iron crucible. The crucible measures 18 in. in diam. and 15 in. in depth, while the outside dimensions of the pot are 29 in. in diam. and 31 in. in depth. The space between the casing and the crucible is filled with a compact heat insulator. The leads of the heating unit are brought over the top of the pot into a connection box fixed to the side of the pot.

General Electric Melting Pot 1,000-Lb.

The pot is designed for melting lead, babbitt, tin, solder, and similar alloys or metals with the exception

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of spelter or zinc, at temperatures not exceeding 850 deg. F. Full automatic control is recommended, and a standard control panel with a temperature control instrument equipped with a special bulb for metal immersion should complete the equipment.

Separate heating units may be installed in existing installations of melting pots where the dimensions permit, provided the temperatures do not exceed 850 deg. Fahrenheit.

"Calorac" Electric Ring Expander

The Humil Corporation, 52 Vanderbilt Ave., New York, N. Y., is marketing the "Calorac" electric ring expander illustrated. The device employs the induction-transformer principle for developing the necessary heat in the ring.

The machine consists of a transformer with the top member of the core hinged for opening to permit the rings being placed over the vertical core. The ring becomes the secondary of the circuit. No hold-down screws or other mechanical device is employed for locking the top member when the transformer core is closed. Instead it is held in tight engagement magnetically by the flux produced in the core when the circuit is closed. The operation is said to be practically noiseless and all chatter is eliminated.

"Calorac" Electric Ring Expander

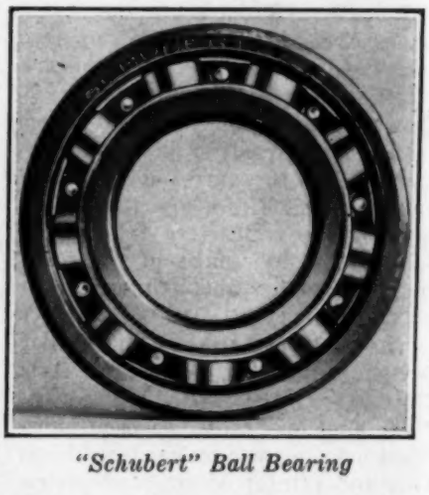
As shown in the illustration, the heater is being used on starting gears to be placed on automobile flywheels. The gear rings measure approximately 15½ in. in diameter and weigh about 5 lb. It is said that one ring can be heated to 500 deg. F. in 40 sec. with 216 volts and 35 amp. A total of 5,500 watt is consumed. Two rings may be heated simultaneously in 60 sec. with the same voltage and 30 amp. of current. The power consumption is 8,000 watts. With this principle of operation, the heat is evenly distributed throughout the ring.

The machine measures 18½ by 40 in. and weighs 850 lb. It has a full load capacity of 12 kva. Any type of ring may be heated on this machine. In the size shown rings up to 30 in. in diameter, and weighing over 200 lb. have been successfully handled. The machine may also be used for heat-treating up to 1,200 deg. F. Pyrometer control is optional.

"Schubert" Ball Bearings

McGill Metal Co., Valparaiso, Ind., is marketing a deep-groove type ball bearing in standard sizes, both single and double row. One of these bearings is illustrated. It is claimed that the dimensional tolerances have been reduced to approximately one-half of the standard S.A.E. tolerances. In addition, it is claimed that particular attention has been given to the finish of the high-carbon alloy steel surfaces of the races and the balls. Since the bearings are of the deep-groove, non-filling slot type, they are capable of carrying axial or thrust loads in either direction.

The retainer of the bearings is made of McGill metal, which is a modified aluminum bronze that may be die-cast within very small tolerances. The metal has physical properties closely approximating mild steel. It is claimed that with this high strength and ductility, together with lightness it is possible to use smaller sections than has heretofore been practical. The decrease in weight of the retainer is important, especially at high speed.



"Schubert" Ball Bearing

It is further claimed that the high inherent heat conductivity of the bronze tends to dissipate any heat localized at the contact of the ball. The use of bronze is said to result in a lower coefficient of friction on the ball against the retainer. To further reduce friction between the balls and the retainer, the ball pockets are cylindrical, and the ball contacts with the retainer in a line. The retainer is supported on the ground and polished land of the inner ring. Cylindrical pockets are said to be desirable, particularly when the bearing is carrying combined radial and thrust loads.

Black & Decker Ball-Bearing Electric Drill, ¼-In.

The Black & Decker Manufacturing Co., Towson, Md., announces an improved ¼-in. standard ball-bearing electric drill. This drill is intended to replace the light ¼-in. drill made by this company.

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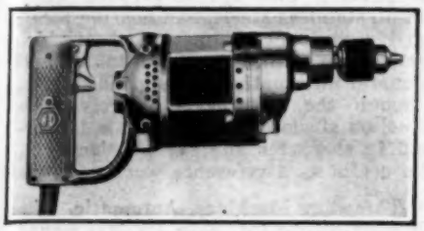


Black & Decker Ball Bearing Electric Drill, ¼-In.

The drill is provided with an improved universal motor that drives the chuck through a double reduction gear unit. The no-load chuck speed is 2,000 r.p.m. All rotating shafts are mounted upon ball bearings.

The drill is equipped with a Jacobs 3-jaw geared chuck. It is also provided with 7½ ft. of Duplex electric cable fitted with an attachment plug and a patented taper molded-rubber cord protector, where the cable enters the switch.

The tool has a capacity in steel of drilling holes up to ¼ in. in diam. The unit weighs 5 pounds.

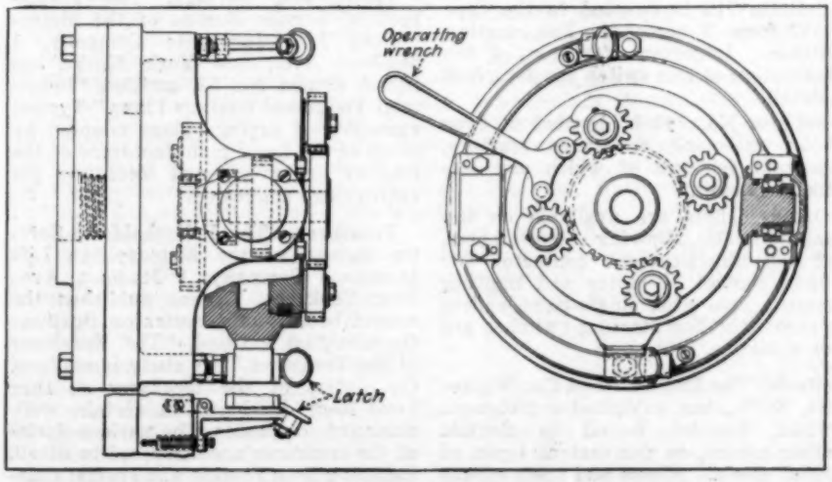
Garrison Duplex Gear Chuck Mounted on Indexing Fixture

The Garrison Machine Works, Dayton, Ohio, announces an adaptation of their standard duplex gear chuck to an indexing fixture for the purpose of accurately grinding deep holes of relatively small diameter from both ends of an automotive gear cluster. After the hole has been ground to the desired depth from one end of the gears, the chuck is indexed through 180 deg. and the opposite end of the hole is presented to the wheel. The remainder of the grinding is then finished. It is claimed that with this method of grinding a shorter and stiffer wheel spindle can be used than would otherwise be possible, and in this way greater accuracy and speed is obtained in grinding.

The construction of the fixture comprises a standard Garrison duplex chuck, containing an indexing lug, mounted upon trunnions in ball bearings. The ball bearings are supported in a rigid base of symmetrical construction. The fixture is mounted on the face-plate of the grinder work-spindle, and after it is trued up it requires no further adjustment.

Latches are provided so as to automatically lock and hold the chuck in either position without exerting any undue pressure or strain upon any part of the chuck or fixture. The latches are released for indexing by a light touch of the operator's finger.

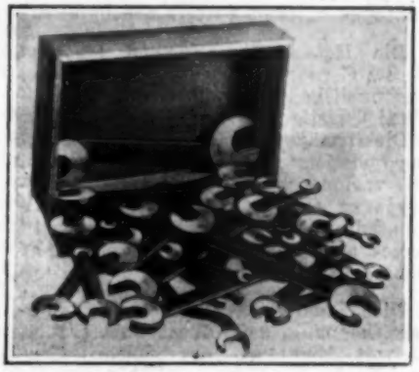
In operation, the gear is inserted in the chuck, and is located and locked in position on the pitch line of teeth by means of a removable operating wrench. Both ends of the gear are locked or unlocked simultaneously for loading or unloading of the chuck by a single movement of this operating wrench shown in the illustration.



Garrison Duplex Gear Chuck Mounted on Indexing Fixture

Bonney Wrench Set No. 650

A complete set of wrenches for general repair work is announced by the Bonney Forge Tool Works, Allentown, Pa. It is known as set No. 650, and it consists of thirty high-grade carbon steel wrenches in a wide range of sizes and types. The assortment includes double-end engineers' wrenches for U.S.S. and S.A.E. nuts and cap screws, valve-tappet wrenches, and a special wrench for the reverse gear and brake band adjustments on Ford cars.



Bonney Wrench Set, No. 650

The set has been especially selected for the repair shop or the mechanic requiring a complete assortment of wrenches. The wrenches are packed in an individual wooden container as shown.

Trade Catalogs

Air Compressors, Centrifugal, Single-Stage. The General Electric Co., Schenectady, N. Y., has issued a 4-page leaflet on its single-stage centrifugal air compressors. The construction of these units is explained in detail by means of a phantom photograph and boxed captions. Characteristic curves and ratings are given.

"Belt-Slacker." Harry M. Perry, 702 N. Main Street, Los Angeles, California, has published a 4-page pamphlet on a pivoted idler-pulley type of belt tightener for use with short centers, known as the "Belt-Slacker." The adavntages in principle of operation of this type of drive are explained. Typical installations are illustrated by means of line cuts and photographs. Engineering data are also included.

Clutch for Stoker Speed Shaft. The Combustion Appliances Co., Wellington,

Ohio, has published a leaflet on its so-called "Grief-Proof" speed shaft clutch for use in replacement work on standard stoker drives.

Counterbores, Spotfacers and Core Drills. The Gairing Tool Co., Detroit, Michigan, has published Catalog No. 19 on its various types of counterbores, spotfacers and core drills. The catalog contains 78, 6x9-in. pages, and is profusely illustrated by means of photographs and line cuts. Complete specifications of these tools are given and some useful tables are appended.

Cutters. The Illinois Tool Works, 2501 North Keeler Ave., Chicago, Ill., has issued a leaflet entitled, "A Victim of Circumstances," in which the advantages of their cutters are implied.

Die Heads. The Eastern Machine Screw Corporation, New Haven Conn., has published a pamphlet entitled, "18 Vital Question to Ask When Selecting a Die Head." By means of these leading questions and the answers thereto, the various characteristics and advantages of the H & G die heads are pointed out. The pamphlet contains 16 pages and is illustrated by means of photographs.

Dies, Stamping. The Detroit Stamping Company, 3445 West Fort Street, Detroit, Michigan, has published General Folder No. 12 on its combination die sets for stamping flat and concentric washers. The pamphlet is illustrated.

Fatigue Machine. The Thompson Grinder Co., Springfield, Ohio, has issued Bulletin No. 1 on the R. R. Moore Fatigue Machine. The value of fatigue tests that will eliminate service failures is emphasized, and the requirements of a satisfactory fatigue testing machine are pointed out. A complete technical description is then given of the R. R. Moore machine, and its chief characteristics and advantages are pointed out. The pamphlet is illustrated by means of a photograph and line cuts.

Hoists, Electric. The American Engineering Co., Philadelphia, Pa., has issued a 42-page, 8½x11-in. booklet on its "Lo-Hed" electric hoists. Various applications of this hoist in many industries are shown by means of photographs. The constructional features of each particular hoist are pointed out, and the operation of each is explained in detail. Complete dimensional tables are given for all sizes and classes of hoists. A large number of illustrations help to make this catalog very attractive in appearance.

Lathes. The Cincinnati Lathe & Tool Co., Oakley, Cincinnati, Ohio, has published a pamphlet in which are pointed out the various advantages of the Cincinnati lathes. Each particular point is amplified by means of a photograph and an explanatory note.

Lighting Equipment, Industrial. The Westinghouse Electric & Manufacturing Co., George Cutter Works, South Bend, Indiana, has issued Catalog 47-A, on Industrial Lighting Equipment. The catalog contains thirty-two, 8½x11-in. pages and is profusely illustrated by means of photographs and line cuts. Useful information for planning industrial lighting installations is given.

Optical Measuring Instruments. The Commercial Tool Co., 2026 East 22nd Street, Cleveland, Ohio, has issued a leaflet on the Carl Zeiss Optical Measuring Instruments. The Optimeter, the toolmaker's microscope, and the Optical Dividing Heads are described in turn. Numerous photographs are used to amplify the text.

Reamers. The Commercial Tool Co., 2026 East 22nd Street, Cleveland, Ohio, has issued a leaflet on the "Reamrite" tools made by the Greenfield Tap and Die Corporation. An explanation is given of the operation and construction of this tool. Complete specifications are given. The leaflet is well illustrated.

Screw Machines. The National Acme Co., Cleveland, Ohio, has published an 8-page, 8½x11-in. pamphlet on its Model B multiple-spindle automatic screw machine for handling round stock up to 3⅛ in. in diam. The outstanding features of the machine are explained in detail and numerous photographs are used to supplement the text. A list of the principal specifications and the floor and overhead plans for setting up the machine are also given.

Speed Reducing Transmission. The Morrison Machine Co., Paterson, New Jersey, has issued a pamphlet on its combination spur and helical gear speed reducing transmission. The bulletin is profusely illustrated by means of photographs.

Starting Switches. The Allen-Bradley Co., Milwaukee, Wis., is publishing a series of bulletins on its various types of starting switches. The bulletins have perforations for loose-leaf binding and are all illustrated by means of numerous photographs.

Bulletin No. 600 is devoted to the description of alternating-current resistance starters. The discussion is highly technical. The characteristics of squirrel-cage motors are first considered, and then the requirements of a starter for such service are mentioned. A comparison is then made between the operating characteristics of a compensator-type starter and a resistance-type starter, with particular reference to voltage disturbances.

Bulletin 710 is devoted to the type J-1552 form T across-the-line starting switches. Important features of the construction of this switch are described in detail.

Bulletin No. 740 is devoted to type J-3052 automatic resistance starters, important features of which are described in detail.

Other leaflets are available on the semi-automatic, slip-ring motor starter, and the direct-current contactor for remote control of motor and lighting circuits. Two other single-page leaflets on across-the-line starting switches are also available.

Steels. The Ludlum Steel Co., Watervliet, N. Y., has published a 202-page, 5x7½-in. booklet, bound in flexible leather covers, on the various types of special steels. Alloys and their effects upon steel are first discussed, followed by an exposition of the composition and heat-treatment of carbon and alloy tool steels. Instructions for working these steels and high-speed steels are also given. Special carbon tool steel, alloy tool steel, and special-purpose alloy steel, stainless steels, ball bearing steel, and permanent magnet steel are described in turn. Standard tables and general information are appended. Although the text deals entirely with Ludlum steels, the treatment is technical in character and should, therefore, be useful as a reference work.

Threading Machines, Automatic. The Rickert-Shafer Co., Erie, Pa., has issued bulletin No. X, series No. 2-S, on its R-S automatic single-spindle threading and second-operation machines, capacity of 2 in. and above. Some of the noteworthy features of the machine are briefly described with the aid of a few photographs.

Threading Tools. The National Acme Co., Cleveland, Ohio, has published an 8-page bulletin on its style S hand die and its style R revolving die threading tools. The features of the construction of the tools are explained and complete specifications are given. The bulletin is illustrated by means of many photographs.

Tramrail Systems. The Cleveland Electric Tramrail, division of The Cleveland Crane & Engineering Co., Wickliffe, Ohio, has published a bulletin entitled "Moving Is the Most Expensive Part of Making." Several typical applications of the Cleveland Tramrail Systems are described and illustrated by means of photographs.

"Unishear." The Unishear Co., Inc., 170 Fifth Avenue, New York, has published a directory of the users of the "Unishear" cutting tools. The various users are classified as to trades and are further divided as to production or maintenance demands. Complete specifications of the Unishear cutting machine are given. A list of representatives is also included.

Pamphlets Received

Thrift and Savings. The Policyholders' Service Bureau of the Metropolitan Life Insurance Company, 1 Madison Ave., New York, N. Y., has issued Report No. 52, entitled, "Industrial Thrift and Savings Plans." Typical examples of savings plans adapted by some of the large manufacturers of the country are given, and incentives for savings are suggested.

Treasurer. The Policyholders' Service Bureau of the Metropolitan Life Insurance Company, 1 Madison Ave., New York, N. Y., has published the second booklet of a series on Business Organization entitled, "The Functions of the Treasurer." A study is made of the duties of the treasurer as they have been developed in certain well-managed companies. The various duties of the treasurer are discussed in detail, including both routine and special functions of that officer.

News of the Week

American and International Foundrymen Join in Convention at Detroit

Elimination of waste discussed at several sessions

The Thirtieth Annual Convention and Exhibition of the American Foundrymen's Association, and the Second International Foundrymen's Congress, were held in Detroit, Sept. 27 to Oct. 1. The exhibits opened Sept. 25 but were not entirely set up until the 27th. The technical sessions extended from Sept. 27 to Oct. 1 inclusive, and covered a wide variety of foundry subjects. In addition to the papers dealing directly with sand, molds, castings, etc., there were discussions on apprentice training, foundry costs, refractories, and the elimination of waste. There were also two foreign language sessions, and a foundry instructors' dinner, in addition to the annual banquet and a concert, entertainment and dance. Visits to nearby plants were part of the program.

NUMBER OF EXHIBITS LARGE

The convention was held at the State Fair Grounds, about 8 miles from the center of the city, the buildings containing ample space for exhibits of various kinds. The dirt floor in the center of the Agricultural Building gave a real foundry air to the molding machines and similar exhibits, and the Dairy Barn lent itself to even larger exhibits in the same way. The number of exhibits was large and many of them were most attractive. The exhibitors expressed themselves as pleased with the number and class of visitors. This exhibit, it will be remembered, aimed at quality rather than quantity in its visitors. There were no complimentary tickets, each visitor paying a registration fee of $1 for a badge good during the show or 50c. for a single admission. As a result, the visitors, though smaller in number than at some other exhibitions, were, in reality, more interested.

Among the exhibitors were: Adams Co. Dubuque, Iowa; Agnew Electric Welder Co., Milford, Mich.; Air Reduction Sales Co., New York, N. Y.; Ajax Electrothermic Corporation, Trenton, N. J.; Ajax Metal Co., Philadelphia, Pa.; American Electric Motors, Inc., Milwaukee, Wis.; American Engineering Co., Philadelphia, Pa.; American Steel Abrasives Co., Galion, Ohio; Atkins & Co., Indianapolis, Ind.; Automatic Transportation Co., Buffalo, N. Y.

Baker-Raulang Co., Cleveland, Ohio; Bellevue Industrial Furnace Co., Detroit, Mich.; Bethlehem Steel Co., Inc., Bethlehem, Pa.; Black Diamond Saw & Machine Works, Inc., Natick, Mass.; Black & Decker Manufacturing Co., Towson, Md.; Boyer-Cambell Co., Detroit, Mich.; Bradley Washfountain Co., Milwaukee, Wis.; Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.; Buckeye Portable Tool Co., Dayton, Ohio.

Carborundum Co., Niagara Falls, N. Y.; Carr Fastener Co., Cambridge, Mass.; Carter Bloxonend Flooring Co., Kansas City, Mo.; Chicago Pneumatic Tool Co., New York, N. Y.; Chisholm-Moore Manufacturing Co., Cleveland, Ohio; Clark Tructractor Co., Buchanan, Mich.; Cleveland Pneumatic Tool Co., Cleveland, Ohio; Clipper Belt Lacer Co., Grand Rapids, Mich.

Detroit Electric Furnace Co., Detroit, Mich.; Detroit Hoist & Machine Co., Detroit, Mich.; Diamond Machine Co., Providence, R. I.; Dixon Crucible Co., Jersey City, N. J.; Electric Controller & Manufacturing Co., Cleveland, Ohio; Electric Furnace Co., Salem, Ohio; Electric Welding Machine Co., Detroit, Mich.; Elwell-Parker Electric Co., Cleveland, Ohio.

Fairbanks, Morse & Co., Chicago, Ill.; The Falk Corporation, Milwaukee, Wis.; Globe Steel Abrasive Co., Mansfield, Ohio; Harnishfeger Corporation, Milwaukee, Wis.; R. G. Haskins & Co., Chicago, Ill.; Howell Electric Motors Co., Howell, Mich.; Independent Pneumatic Tool Co., Chicago, Ill.; Ingersoll-Rand Co., New York, N. Y.; International Nickel Co., New York, N. Y.

W. H. Keller, Inc., Grand Haven, Mich.; Keller Mechanical Engineering Corporation, Brooklyn, N. Y.; Keystone Lubricating Co., Philadelphia, Pa.; Lakewood Engineering Co., Cleveland, Ohio; Lewis-Shepard Co., Watertown, Mass.; Link Belt Co., Chicago, Ill.; Londen Machinery Co., Fairfield, Iowa; Metal & Thermit Corporation, New York, N. Y.

Niclum Metal Corporation, San Francisco, Cal.; Norma-Hoffman Bearings Corporation, Stamford, Conn.; Northern Engineering Works, Detroit, Mich.; Norton Co., Worcester, Mass.; O. K. Tool Co., Shelton, Conn.; Oliver Machinery Co., Grand Rapids, Mich.; Oxweld Acetylene Co., New York, N. Y.; Pangborn Corporation, Hagerstown, Md.; Porter-Cable Machine Co., Syracuse, N. Y.

Quigley Furnace Specialties Co., New York, N. Y.; Racine Tool & Machine Co., Racine, Wis.; Reeves Pulley Co., Columbus, Ind.; Richards-Wilcox Manufacturing Co., Aurora, Ill.; Rollway Bearings Co., Syracuse, N. Y.; Royersford Foundry & Machine Co., Royersford, Pa.; Ruemelin Manufacturing Co., Minneapolis, Minn.

Safety Emery Wheel Co., Springfield, Ohio; Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.; W. W. Sly Manufacturing Co., Cleveland, Ohio; Standard Safety Equipment Co., Chicago, Ill.; Sullivan Machinery Co., Chicago, Ill.; Sundstrand Machine Tool Co., Rockford, Ill.; Tabor Manufacturing Co., Philadelphia, Pa.; Taylor Instrument Co., Rochester, N. Y.; Transmission Ball Bearing Co., Buffalo, N. Y.

U. S. Electric Tool Co., Cincinnati, Ohio; Wadkin & Co., Leicester, Eng.; Warner & Swasey Co., Cleveland, Ohio; Jervis B. Webb Co., Detroit, Mich.; Weldit Acetylene Co., Detroit, Mich.; Whiting Corporation, Harvey, Ill.; Yale & Towne Manufacturing Co., Stamford, Connecticut.

Conference on Chemical Exports at Capitol

For more than a year the production of chemicals in the United States has exceeded that of any other country. With the idea of maintaining that position and for the purpose of giving greater stability to the industry, the Secretary of Commerce, at the request of various chemical organizations, will invite the principal executives of all chemical manufacturing concerns to assemble in Washington on Nov. 7 for a conference.

The principal purpose of the gathering is to give impetus to "the will to export." The feeling at the Department of Commerce is that the chemical industry is too dependent on the domestic market. If the volume of exports could be doubled it would be an important safeguard against possible recession of domestic demand. Our exports would have to be quadrupled before they would bear the same relation to production as do the exports of the principal other chemical manufacturing countries. It is with the hope of removing this element of weakness that the department desires to imbue the industry with the zeal necessary to go forth and annex more of the world trade.

American Society of Agricultural Engineers to Study Farming Problems

Plans to create farms engineered like factories will be discussed at a meeting of the North Atlantic Section of the American Society of Agricultural Engineers, at State College, Pa., Oct. 11 to 13.

"Results of the Farm Equipment Research Survey," "Dilution of Crankcase Oil in Kerosene Burning Engines," and "Requirements for Farm Building Paints," will be among the papers presented at the meeting.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

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THE wealth that the war has brought us and the magnitude of our resources, latent and developed, have been so widely acclaimed and advertised that everyone feels opulent and willing to spend money. It has been seriously argued that our economic organization and the education in economics that we have received since 1914 have made a recurrence of hard times impossible and it is announced that "prosperity is ours" will be the battle-cry of one of the political parties in the coming election.

Meanwhile Henry Ford has adopted the five day week upon the theory that by intensive work his employees can produce as much in five days as they formerly turned out in six and some predict that the industrial week will soon be shortened to four days of eight or seven hours each. There is, in fact, a widespread inclination to admit that we may be approaching an economic millenium in which we can spend as much and work as little as we like and this fact is responsible for the present resiliency of the stock market and the improvement in trade of which we hear so much.

Since there is nothing in sight at the moment to cause a reversal of sentiment it seems reasonable to expect a continuance of good times at least until something happens to change the public mood.

But this is not to say that prices will go higher. Call money loaned at 6 per cent last week, interest rates are hardening and on the Stock Exchange the tide seems to be at the flood. Occasionally there is a languid wave that runs a little farther up the beach than its predecessors but it recedes, and it is sometime before another reaches high water mark. The wish is father to the hope that the Nickle Plate consolidation will soon be consummated and this hope has inspired so many to buy railroad stocks that its disappointment might have a dispiriting effect.

Under the lead of United State Steel and the "melon" that is supposed to be growing on its common stock, some industrials have also advanced, but so many issues are now traded in on the curb and over the counter as well as on the Exchange proper that it is almost impossible to generalize in regard to prices or trend. But it may at least be said that people still continue to ask "What shall I buy?" and that the actual turn in the tide will probably be deferred until they commence to inquire "Shall I sell now or wait?"

On the commodity exchanges the story is somewhat different although the moral is the same. Cotton is about the only article that has shown any activity, but the market was a declining one until Tuesday when it reacted upon Southern advices which indicated that the South was preparing to hold and organize for the reduction of next year's acreage.

The result has been more or less buying by manufacturers who are encouraged to stock up by the excellent demand for cotton goods that is indicated by a report of the Association of Cotton Textile Merchants in New York. This report asserts that sales of cotton textiles have exceeded production by 47¾ per cent for the eleven weeks ending September 15, and that unfilled orders on September 15 showed an increase of 91¼ per cent over July first. These figures were a distinct surprise to the normally melancholy cotton spinners and for the present at least the sting has been taken out of the latest government estimate. But it cannot be said that there is any widespread speculation in cotton as yet nor is it likely that any will develop until the season is several months older.

The other textiles, silk, rayon, and woolen goods, are also looking up and distributive trade is upon the whole better than it has been for sometime.

New construction is still on the wane. The railroads are no longer clamoring for more equipment and the steel mills are becoming more dependent upon the automobile manufacturers who evince their faith in the future by their production plans.

A sharp advance in ocean freight rates is a development which makes ship owners and the U. S. Shipping Board thankful. It is attributed to the English coal strike and the resulting demand for vessels that can carry American coal to Great Britain whose plight almost seems to warrant the gloomy predictions of the "gloomy Dean" Inge in his latest book about the British Empire.

But there are many who do not agree with the pessimistic Dean and the most recent advices are that the miners are going to work in the pits that can be most easily and profitably worked.

A decline that has carried silver to 57¾ cents an ounce, which is the lowest price since 1915, is widely commented on. It is ascribed to the prospective re-establishment of the gold standard in India and it will probably provoke an outcry from silver miners everywhere.

But none of the week's developments can be regarded as symptomatic of an fundamental change and with railroad earnings and car loadings making new high records it must be admitted that business has an impetus that will carry it well into the winter unless it runs off the track or into some obstacle that is presently invisible.

What's Doing in Industry

Since there is nothing in sight at the present moment to cause a reversal of sentiment, it seems reasonable to expect a continuance of good times at least until something happens to change the public mood.

The trend of industry as a whole has been upward, though not so steeply as was hoped for in the machinery industry during September. Special equipment orders have been frequently placed both in the West and in the East but standard tools have not found a very ready market.

The orders which have been placed during the past month have come mainly from the industrial class. Reports throughout the country are fairly uniform as to the number of orders placed compared with the two previous months.

In some sections, particularly in Detroit and in Canada, a few orders have come from railroad sources. Automotive orders have been for replacement purposes and in rather small lots. Heavier buying is looked for from this source as soon as the increased spring production of cars begins.

None of the week's developments can be regarded as symptomatic of any fundamental change and with railroad earnings and car loadings making new high records it must be admitted that business has an impetus that should carry it well into the winter.

The immediate prospects for October are good and considerable activity is expected. The National Steel and Machine Tool Exposition held at Chicago during the latter part of September will probably contribute to an increase in the number of orders placed this month.

The Industrial Review

Progress of the machinery and machine tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

New England

Machinery builders and contracting machinists in the New England territory report that buying during the past fortnight has been largely for replacements in the automotive and farm machinery fields. There has also been some scattered buying for railroad shops and car equipment manufacturers.

The volume of business booked continues to bear the same relation to production that has been maintained in the past three months and it is clear that the industry will still be active for some months to come. Special machinery builders have business calling for production on overtime schedules for four to six months at least. Automatic production and small tool machinery demands are good. Chucks and dies are in strong demand. A slight increase in foreign business was commented on by some officials.

Cincinnati

Business is reported by the majority of the machine tool manufacturers and selling agents in the Cincinnati districts as having been on the up-grade through the past week and the general feeling is that business will continue to get better as the fall advances.

While some express the opinion that the demand will reach its peak the latter part of October, a greater number believe that the sales-curve will not reach its high point until the end of November, or even later than that. Small machine shops are getting busier, as well as industrial users of tools. Although the individual purchases of these two groups are comparatively small, they are large in the aggregate and form the backbone of the machine tool market.

In the past week, the orders were for single tools and replacements and were well diversified, coming from all kinds of users and from all sections of the country. There was an increased number of inquiries, quite a few being for fair-sized lists.

Railroads are reported to have done more buying than in the previous week but their purchases are still regarded as being far below the actual needs. The automotive orders were largely for replacements but considerable buying was done.

New York

The New York machinery market definitely improved during the month of September, although the rate of improvement has disappointed many. It was thought that by the end of September the machinery market would at least reach if not surpass in volume of business the activity which it underwent previous to the summer recession. The general consensus of opinion seems to be that it has merely improved.

The immediate prospects for the month of October however, are good and it is almost certain that by the first of November there will be renewed vigor in the machinery industry. Lists which have been long pending must soon be acted upon and, although the selling work was long ago completed, the results will be on the credit side for this month. The sales for the past week have been fairly well balanced and include in the industrial group, a set of plate bending rolls, four profiling machines, two multiple-spindle drilling machines, one hob and cutter grinder, one contour grinder, a planer, two centerless grinders and also presses.

Orders placed by railroads in this territory include a 36-in. x 36-in. x 10-ft. planer, a side-head boring mill, 1,500-lb. steam hammer and a 100-ton bushing press. The automotive industry has placed orders for a 16-in. geared-head lathe and a 6x48-in. thread miller. The inquiries for the past week have been principally from the industrial class but include railroad replacement lists. A manufacturer of equipment for welding states that business in this line has undergone a period of phenomenal prosperity during the last two or three months.

Detroit

With all signs pointing to the greatest automobile production in history this year selling agents for machine tools and machinery are anticipating a very material increase in the volume of sales during the next few months.

Most of Detroit's and Michigan's plants are purchaing machines here and there. Most of the orders are for single machines, although in some instances purchases are for more than one unit. Small tools are finding a ready market, and most of the plants are trying to tool up for the heavy fall and winter production which is everywhere anticipated.

Railroads are buying tools and machinery in fair quantities. The Michigan Central is spending nearly half a million dollars this year in new machinery alone.

Canada

The arrival of autumn finds the industrial situation in Canada highly gratifying, as a consequence of which dealers in machinery and machine tools look forward to good business during the remainder of the year. Not since 1920 has the country been as prosperous as it is today, and the indications are that there will be a great deal of industrial expansion during the next few years.

Engineering shops throughout eastern Canada are reported to have much work on hand. The John Inglis Co. of Toronto, has received orders for three 18,000-hp. turbine units for the Ontario Hydro Electric Power Commission; six turbines for the Backus-Brooks Co., totalling 18,000 hp., and one turbine of 13,000 hp. for the Ontario Paper Co. The Montreal Locomotive Co. has received an order from the Newfoundland Railway for one type 462S locomotive, weighing 124 tons. An order has also been received for three locomotives, from the U. S. Gypsum Co., Windsor.

President Butler of the Canadian Car and Foundry Co. recently expressed the opinion that considerable railroad work would be forthcoming in the near future, basing his assumptions on the fact that Canadian railroads are in need of a large amount of equipment, and that railway earnings will be boosted by a good harvest.

The recent decision of the Canadian Locomotive Co. to enter the field of manufacture of mining equipment, and its affiliation with the Colorado Fuel and Iron Co. to this end, have proven very successful. There are enough mining equipment orders on the books to keep the company going until the middle of November, and it is expected the factory at Kingston, Ontario, will be kept going all winter.

Chicago

The month of September closed without material change in the machine tool market from the level maintained during the last several weeks. Reports from dealers, as a rule, are to the effect that the volume of business transacted was about on a par with that of August, if anything a little better. The full effects resulting from the machine tool exposition recently held at the Municipal Pier have not had sufficient time to develop.

Exhibitors express themselves as greatly pleased with the business, actual and prospective, which the exposition was directly responsible for, many out of town concerns having placed substantial orders. Dealers in used tools, who rather expected an unfavorable effect on their business from the show, are agreeably disappointed, no reaction of this nature having been experienced; if anything, they have been benefited, due to the large influx of buyers from various sections of the country. Railroads are still inactive in the matter of closing lists, such buying as they are doing being limited to small lots. With the exception of a few standard type tools bought by farm machinery manufacturers, no sales of importance have been reported during the last week.

Indianapolis

While September of this year will show an increase in sales of machine tools and machinery over the same month of last year, the situation is hardly as good as the industry had expected. Inquiries continue in sufficient numbers to lend some encouragement for expecting a larger volume in October. It is estimated that the sales volume for September was about 12 per cent above the volume for last year. This shows that September held its own as compared with the previous months, for the average increase per month ranges from 10 to 15 per cent.

Demand from the automobile manufacturers appears to be active. Individual orders are not large, but they are frequent. It is believed that before the annual spring production increase there will be some machinery replacements in the larger plants. These plants have purchased only that machinery which was absolutely necessary for the past two or three years and some of the equipment is becoming antiquated.

A strong demand continues from contractors for special equipment. This trade has become exceptionally heavy for the last six months. Dealers say it will be even better next spring. The demand from garages for grinding equipment and other special tools is falling off slightly due to seasonal influences.

Railroad buying has been cut to the minimum. There appears to be no future from this source until after the first of the year. Repair schedules have been cut down. Demand from the farm implement factories is fair and should improve during the next month as the factories increase production for the spring shipments.

Schwab Elected President of A.S.M.E.

The tellers of the annual election of officers of the American Society of Mechanical Engineers have announced that Charles M. Schwab has been elected president of the society for the coming year. Mr. Schwab will formally assume his new office at the annual meeting of the society, in New York, in December, at which time he will succeed William L. Abbott of Chicago.

Other new officers announced by the tellers are three vice-presidents, three members of Council and a treasurer. The vice-presidents are: Charles L. Newcomb, manager of the Deane Works of the Worthington Pump & Machinery Corporation; Everett O. Eastwood, professor of mechanical engineering at the University of Washington, Seattle; and Edwards R. Fish, vice-president of the Heine Boiler Co., St. Louis. The three new members of Council are: Col. Paul Doty, chairman of the Minnesota State Board of Registration for Architects, Engineers and Land Surveyors; Ralph E. Flanders, general manager of Jones & Lamson Machine Co., Springfield, Vt.; Conrad N. Lauer, treasurer and general manager of Day & Zimmermann, Philadelphia. Erik Oberg, editor of *Machinery*, has been re-elected treasurer of the society.

Power Transmission Association Organizing

A Survey Committee appointed at a meeting of belting, transmission and accessory manufacturers, held in Cleveland on June 10th, met at the Old Colony Club, Waldorf-Astoria, New York, recently to lay the groundwork for the association of manufacturers of these products.

The objects of the association are: to promote the most efficient and economical distribution of power; to make a scientific study of all engineering problems connected with the transmission of power; to accumulate and compile accurate and authoritative information regarding the most economical and efficient power transmitting methods and to place this information at the disposal of all power users through the members of the organization and through planned publicity; and to further the interests of affiliated manufacturers and their distributors making and handling power equipment.

Organized efforts are being made to add to the list of members which follows:

T. B. Wood & Sons Co., Medart Co., Moloney Belting Co., Hans Rees' Sons, Page Belting Co., E. F. Houghton & Co.

Rockwood Manufacturing Co., U. S. Leather Co., Alexander Brothers, I. B. Williams & Sons, Graton & Knight Manufacturing Co.

Clipper Belt Lacer Co., American Pulley Co., Bond Foundry and Machine Co., Royersford Foundry & Machine Co., A. & F. Brown Co.

Security Rubber & Belting Co., Chas. Bond Co., Valley Iron Works, Standard Pressed Steel Co., F. Rainville Co.

Shingle-Gibb Leather Co., Transmission Ball Bearing Co., O'Meara Belting Co., Meier-Andrews Belting Co., Ohio Valley Pulley Works.

Fensholt & Fechner Co., Baltimore Belting Co., Bonner & Barnewell, Inc., Chicago Belting Co., Pyott Foundry Co.

Bay State Belting Co., Kistler, Lesh & Co., Cling Surface Co., Schwartz Belting Co., L. P. Degan Belting Co.

H. N. Cook Belting Co., Holyoke Belting Co., Chicago Pulley & Shafting Co., Sawyer Leather Belting Co., J. A. Webb Belting Co.

Whiting Leather & Belting Co., McAdoo & Allen, E. P. Alexander & Son, Fisher Leather Belting Co., Plant Co.

Brown Clutch Co., W. H. Salisbury & Co., Inc., McLeod Leather & Belting Co., Eagle Belting Co.

Eclipse Wood Pulley Co., McCauley Belting Co., Saginaw Manufacturing Co., Calif. Belting & Supply Co., Klinger-Dills Co.

Baldwin Belting & Leather Co., Chicago Rawhide Manufacturing Co., Detroit Belt Lacer Co., Bickford & Francis Belting Co., Byrnes Belting Co.

Grand Rapids Belting Co., Hide Leather & Belting Co., Hudson Belting Co., Chas. L. Ireson, Inc., Jewel Belting Co., Johnson Leather Belting Co.

Edward R. Ladew Co. Inc., Laurence Belting Co., Missouri Belting Co., New York Leather Belting Co., Norwich Belt Manufacturing Co.

N. Palmer & Co., Geo. Rahmann & Co., J. E. Rhoades & Sons, Chas. A. Schieren Co., Schwartz Belting Co.

Schultz Belting Co., Union Belt Co., Hyatt Roller Bearing Co., Bat Belting & Supply Co.

Storage Battery Locomotive Reaches Chicago

A 110-ton storage-battery switching locomotive, the largest of its kind ever manufactured in this country, left the Erie works of the General Electric Co., Oct. 1, for Chicago. The trip of 450 miles was made by the locomotive under its own power, drawing a passenger coach. The locomotive will be used in the freight yards of the Chicago & Northwestern Railway and is capable of pulling any freight train now moved in Chicago, it is said.

The battery weighs more than thirty-nine tons and will be recharged at night when the locomotive is idle, by means of special equipment. In emergency it can be recharged while the locomotive is in operation, by means of a small gas engine generator installed in the cab, but it has capacity to operate the locomotive for an average day's work.

Fair Trade League Becomes Fair Trade Association

The members of the American Fair Trade League have voted unanimously in favor of substituting the word "Association" for the word "League" in the name of the organization.

The objects of the Fair Trade Association are: to aid in the re-establishment and continuance of fair competitive commercial conditions; to promote honesty in manufacturing, in advertising, and in merchandising, for the mutual interest of the consumer, the middleman and the manufacturer; to bring to the public attention the existing evils in merchandising methods which operate to the injury of society; to act as a clearing house of information concerning trade practices and systems, and legislation relating thereto; to aid in securing the enactment and enforcement of laws, state and national, that will prohibit and penalize unfair competition, prohibit and penalize dishonest advertising, prevent the elimination of the smaller business man by unfair methods.

Budgeting Technique to Be a Feature of A.M.A. Convention

The American Management Association is completing the details of its program for the autumn convention of the association to be held at the Hotel Statler, Cleveland, Ohio, Oct. 11, 12, and 13. "Trends in Methods of Distribution," will be the general topic for sales executives on Oct. 11. The following day will be devoted to budgeting technique. Many papers have been prepared by a number of well-known men in this field. Wednesday, Oct. 13, will be devoted to problems of management organization.

National Electrical Manufacturers Organize

Organization of the National Electrical Manufacturers' Association, composed of 270 manufacturers whose aggregate gross annual business exceeds 1½ billion dollars, was announced recently.

Gerald Swope, president of the General Electric Co., was chosen president at the first meeting of the board of governors. J. W. Perry, vice-president of Johns-Manville, Inc., was made treasurer.

An important consideration of the new organization will be the standardization of electrical apparatus, with a trend to lowering costs to both the distributor and the consumer. The association will co-operate with the Department of Commerce in standardization and simplification. The general purpose of the organization is to advance the manufacture of dependable electrical equipment.

Sensitive Tests Require Careful Preparation

Comparison of the lengths of two graduated bars or scales is one of the fundamental standardizing processes required by modern science and industry which are carried out at the Bureau of Standards in Washington. This delicate test is conducted by means of machines called "comparators." The observations are made with micrometer microscopes because on precision standards the lines are usually too fine to be seen with the naked eye. The temperature of the bars must be controlled by placing them in constant temperature baths.

In the calibration of a precision standard such as is used in many re-

search laboratories, in some instrument-making shops, and elsewhere, many other precautions are necessary in order to obtain the desired precision. Care must be taken as to the points at which the bar is supported, and attention paid to insure that the illumination of the lines is made symmetrical. The room in which these comparisons of length standards are made is well-insulated. It is a basement room and to enter it one must pass through three doors in succession, the last door being one such as is used for entrances to cold-storage rooms in meat markets.

But even the heat from the observer's body would be sufficient to affect the temperature of a part of the bar, and hence its length, if the bar were not in a constant temperature bath insulated to a considerable extent from possible external temperatures.

Obituaries

GEORGE W. MITCHELL, for many years a buyer for the Hydraulic Machinery Co., Montreal, Canada, died recently at his home in Outremont, a suburb of Montreal. Before joining the Hydraulic Machinery Co., he was associated with the Laurie Engineering Co. for a number of years.

Personals

GILBERT H. UNRUH has been appointed as Baltimore representative of the Link-Belt Co., Chicago, Ill. He is temporarily located at 618 Regester Ave., Stoneleigh, Baltimore County, Md.

J. B. GOUGH has joined the engineering staff of Price Bros., Ltd., Quebec. He was formerly connected with the Newfoundland Power and Paper Co., Corner Brook, Newfoundland.

JOHN J. SHEEHAN, who recently retired as toolroom supervisor of the Roanoke Shops of the Norfolk and Western Railway Co., after a period of service of 43 years, was tendered a complimentary banquet by the employees of the tool department at the Hotel Roanoke, Roanoke, Virginia.

E. W. WOLFSTYN, assistant treasurer of the Graybar Electric Co., New York, N. Y., has been appointed as credit manager of the Pittsburgh distributing house of this company. He was formerly assistant general credit manager of the supply department of the Western Electric Co., New York, N. Y.

R. C. BROWER has been appointed as general manager of the Timken Roller Bearing Co., Canton, Ohio. He has been associated with the company for four years in both the automotive and industrial machinery sales divisions. He was formerly eastern and central district manager of the Bearing Service Co., which was absorbed by the Timken organization.

FRANK C. EATON has been elected president of the Pittsburgh Tool Steel Wire Co., Monaca, Pa. GEORGE H. STENGEL was elected vice-president and RALPH H. PAULEY, secretary and treasurer. Mr. Eaton was formerly vice-president and Mr. Pauley, secretary. Both succeeded to offices made vacant by the recent death of Godfrey Stengel, Jr.

VICTOR LARSON will be in charge of the recently opened Montreal office of Arthur Jackson, Toronto, Canada, who is the direct factory representative for a number of American machine tool manufacturers, specializing in mass production tools. Mr. Larson is familiar with this class of machinery and with machine shop methods. He was formerly connected with the Canadian Ingersoll-Rand Co., but for the past few years he has been managing director of the Sleeper and Ackhurst Co., Coaticook, Quebec.

HIRAM N. CUDWORTH, who has been connected with the Norton Co., Worcester, Mass., for more than 20 years, has retired as district manager for the machine division of the company, in Chicago. He retains his association with the company in a consulting capacity. OSCAR E. NORDSTROM, formerly district manager for the machine division, in Cleveland, succeeds Mr. Cudworth at Chicago. M. E. MATTSON, a representative in the Chicago district has been appointed district manager in Cleveland. GEORGE M. BOWEN, who has resigned as a grinding wheel salesman in Detroit, will be succeeded by KARL E. HERRICK, who was connected with the Norton sales organization several years ago as a grinding wheel salesman and assistant sales manager of the refractories division. C. H. HILL, who has been located in Indianapolis, will have his headquarters at the Chicago office but will continue as representative of the company in Indiana, Kentucky and Missouri.

Business Items

The Maple Leaf Steel Mills, Ltd., Edmonton, Alberta, Canada, has been incorporated.

The Gasque Mattress Co., of Dillon, S. C., has placed orders for additional machinery for its plant. The capacity of the plant will be increased to three times its present output.

The G. J. Parker Tool & Die Co., Meriden, Conn., has incorporated and will engage in the manufacture of tools and machinery. Sophy L. Collins, Clifford I. Parker and Willis P. Northrop are the incorporators.

The plant and equipment of the American Bolt Corporation, Bayonne, N. J., has been ordered to be sold by Federal Judge Runyon. The concern is a subsidiary of the Hoops & Townsend Corporation of Delaware, which went into receivership Sept. 27, 1925.

The Meyers Machine Co., Alexandria, Ind., has filed articles of incorporation with the secretary of state of Indiana. The company will manufacture automatic glass making machinery. The incorporators are D. S. Meyers, D. S. Meyers, Jr., and George T. Meyers.

The American Can Co. has acquired a large site at North Chicago on which it proposes to erect its biggest plant, the first unit of which will cost, it is said, $3,000,000. The site adjoins the plant of the American Steel & Wire Co., and it will give employment to 700 people.

The Hart & Cooley Manufacturing Co., New Britain, Conn., has declared its regular quarterly dividend of 4 per cent, equal to $1 a share, and an extra dividend of 12 per cent, equal to $3 a share. A subsidiary of this company, the Fafnir Bearing Co., declared a regular dividend of 2 per cent and an extra dividend of 8 per cent, equal to 50c. and $2 a share, respectively.

The National Steel Car Corporation, Ltd., Canada, has published its annual statement for the year ending June 30. The statement shows that operating profits were $151,102, as compared with a loss of $46,336 during the preceding fiscal year. While there has been a decided improvement, the statement points out that only a small percentage of the capacity of the company's works was reached.

The Michigan Central Railroad has purchased the factory building and site of the Peninsular Stove Co. at West Fort Street and Trumbull Avenue, Detroit. The stove company will erect a modern factory on another site but will continue to occupy the present manufacturing plant until the new factory is completed. The site comprises seven acres and will be used by the railroad to extend its freight yard and storage facilities.

A group of General Motors engineers has sailed to visit the London and Paris automobile shows. The following members of the technical committee of the General Motors Corporation, under the direction of H. M. CRANE, technical assistant to the president, sailed on the Olympic: BENJAMIN H. ANIBAL, chief engineer of Oakland; O. E. HUNT, chief engineer of Chevrolet; E. W. SEAHOLM, chief engineer of Cadillac; E. A. DEWATERS, chief engineer of Buick; H. C. M. STEVENS, chief engineer of Oldsmobile, W. H. MOYSE, chief engineer of General Motors of Canada, and W. J. DAVISON, assistant executive secretary. On the same boat sailed KINGSTON FORBES, body engineer of Buick; HARLEY EARL, body designer for Cadillac, both members of the General Motors technical staff, and CAPT. H. L. TOWLE, Duco expert of the Du Pont Co.

Forthcoming Meetings

National Association of Manufacturers. Thirty-second annual meeting, Waldorf-Astoria Hotel, New York, Oct. 5, 6 and 7. George S. Boudinot, secretary, 50 Church St., New York.

American Institute of Mining and Metallurgical Engineers. General meeting, Hotel Schenley, Pittsburgh, Oct. 5 to 9. H. F. Bain, secretary, 29 West 39th St., New York City.

American Management Association. Fall meeting, Hotel Statler, Cleveland, Oct. 11 and 12. W. J. Donald, managing director, 20 Vesey St., New York City.

American Gear Manufacturers Association. Semi-annual meeting, Briarcliff Lodge, Briarcliff Manor, N. Y., Oct. 14, 15 and 16. T. W. Owen, secretary, 2443 Prospect Ave., Cleveland, Ohio.

American Iron and Steel Institute. Fall meeting, Hotel Commodore New York, Oct. 22. E. A. S. Clarke, secretary, 40 Rector St., New York City.

Management Week. National observance, Oct. 25 to 30. General theme—"Progress in Waste Elimination." Organizations cooperating are the American Society of Mechanical Engineers, American Management Association, American Institute of Accountants, Society of Industrial Engineers and the Taylor Society.

National Safety Council. Fifteenth annual safety congress, Detroit, Mich., Oct. 25 to 29. A. A. Mowbray, director, 108 East Ohio St., Chicago.

American Welding Society. Eighth annual fall meeting, in conjunction with International Welding and Cutting Exposition, Broadway Auditorium, Buffalo, N. Y., Nov. 16 to 19. Secretary's headquarters, 29 West 39th St., New York City.

National Exposition of Power and Mechanical Engineering. Fifth event, Grand Central Palace, New York City, Dec. 6 to 11. I. E. Moultrop, chairman advisory committee, Edison Electric Illuminating Co., Boston, Mass.

National Founders Association. Thirtieth annual convention, Hotel Astor, New York, Nov. 17 and 18. J. M. Taylor, secretary, 29 South La Salle St., Chicago.

American Society of Mechanical Engineers. Annual meeting, New York City, Dec. 6 to 9. Details later. Calvin Rice, secretary, 29 West 39th St., New York.

American Association for the Advancement of Science. Annual meeting, University of Pennsylvania, Philadelphia, Pa., Dec. 27 to Jan. 1. Sam Woodley, executive assistant, Smithsonian Institution, Washington, D. C.

Society of Automotive Engineers. Annual meeting, Detroit, Jan. 25 to Jan. 28. W. Delchamps, chairman, meetings and sections department, 29 West 39th St., New York.

The Weekly Price Guide

Rise and Fall of the Market

FIRMNESS prevails in pig-iron with advances in spots; current prices will probably hold for another week; decline in No. 2 fdry. iron at Birmingham, purely local. Steel products hold steadily to quoted levels, particularly the hot-rolled items. Demand appears especially active this week in hoops, bands, strips, plates (steel and tin), sheets, and railway material. Bars and shapes are $2 per 100 lb. and plates, $1.90, f.o.b. Pittsburgh mill, although as low as $1.90, in a single instance, is reported on the first two. Scrap copper is down; lead tends in the opposite direction; fluctuations appear in brass. Linseed oil dropped 7c. in Cleveland and 2½c. per 7½ lb.-gal. at New York, during the week.

(All prices as of Sept. 30)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$24.19
Northern Basic	20.39
Southern Ohio No. 2	21.39
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	27.37
BIRMINGHAM	
No. 2 Foundry	20.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	22.76
Virginia No. 2	28.67
Basic	21.26
CHICAGO	
No. 2 Foundry local	21.75
No. 2 Foundry, Southern (silicon 2.25@2.75)	25.05
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	19.76
Basic	19.76
Bessemer	19.76

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	5.00@5.50
Cleveland	5.00@5.25
Cincinnati	5.00@5.50
New York	5.25@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	Chicago	Cleveland	New York
No. 10	2.30	3.50	3.15	3.89
No. 12	2.35	3.55	3.20	3.94
No. 14	2.40	3.60	3.25	3.99
No. 16	2.50	3.70	3.35	4.09
Black				
Nos. 18 to 20	2.80	3.75	3.50	4.15
No. 22	2.95	3.90	3.65	4.30
No. 24	3.00	3.95	3.70	4.35
No. 26	3.10	4.05	3.80	4.45
No. 28	3.25	4.20	3.95	4.60
Galvanized				
No. 10	3.15	4.10	3.85	4.40
Nos. 12 to 14	3.25	4.20	3.95	4.50
No. 16	3.35	4.30	4.05	4.60
No. 18	3.50	4.45	4.20	4.75
No. 20	3.65	4.60	4.35	4.90
No. 22	3.70	4.65	4.40	4.95
No. 24	3.85	4.80	4.55	5.10
No. 26	4.10	5.05	4.80	5.35
No. 28	4.35	5.30	5.05	5.60

WELDED STEEL PIPE—Warehouse discounts are as follows

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv
1 to 3 in. steel butt welded.	53%	39%	55½%	43½%	54%	41%
2½ to 6 in. steel lap welded.	48%	35%	53½%	40½%	51%	38%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameter in Inches — External	Diameter in Inches — Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at warehouse in lots of less than 100 ft.:

Thickness — Decimal	B.W.G. and Fractions	Outside Diameter in Inches — ⅛	¼	⅜	½	1	1½	1½
		Price per Foot						
.035"	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049"	18	.17	.18	.19	.20	.21	.23	.25
.065"	16	.19	.20	.21	.22	.23	.25	.27
.083"	14	.20	.22	.23	.24	.25	.27	.29
.095"	13	.21	.23	.25	.26	.27	.29	.31
.109"	12	.22	.24	.26	.27	.28	.30	.32
.120" or .125"	11	.23	.25	.27	.28	.29	.31	.33
.134"	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Spring steel (light) (base)*	7.00	6.00@7.50	4.65†
Spring steel (heavier)	4.00	....	4.00
Coppered Bessemer rods (base)	6.05	6.00	6.20
Hoop steel	4.49	3.65	4.15
Cold rolled strip steel	6.25	6.35	6.25
Floor plates	5.25	5.30	5.00
Cold drawn shafting or screw	4.00	3.90	3.60
Cold drawn flats, squares	4.50	4.40	4.10
Structural shapes (base)	3.34	3.10	3.10
Soft steel bars (base)	3.24	3.00	3.00
Soft steel bar shapes (base)	3.24	3.00	3.00
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.20	3.10
Bar iron (3.00 at mill)	3.24	3.21	3.00
Drill rod (from list)	60%	55%	50%

Electric welding wire, New York, 3/32, 8.35c.; ⅛, 7.85c.; 5/32 to ½, 7.35c. per lb. *Flat, ¼@½-in. thick. †F.o.b. cars.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			15.50
Tin, 5-ton lots, New York			72.00
Lead (up to carlots) E. St. Louis	8.42½	New York	9.37½
Zinc (up to carlots) E. St. Louis	7.37½	New York	8.37½

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot.	18.00	20.50	15.00
Copper sheets, base	23.00	23.00	23.00
Copper wire, base	20.00	20.00	20.00
Copper bars, base	22.62½	22.62½	22.50
Copper tubing, base	25.00	25.00	25.00
Brass sheets, base	19.37½	19.37½	19.37½
Brass tubing, base	24.25	24.25	23.75
Brass rods, base	17.12½	17.12½	17.12½
Brass wire, base	19.87½	19.62½	19.87½

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1 to 15 ton lots	27.00	27.00	27.02
Zinc sheets (casks)	13.25	13.05	12.01
Solder (½ and ½), (case lots)	43.50	44.00	38½@42½

Babbitt metal, delivered, New York, cents per lb.:

Genuine, highest grade	88.00
Commercial genuine, intermediate grade	61.00
Anti-friction metal, general service	31.50
No. 4 babbitt (f.o.b.)	14.75

Nickel, f.o.b. refinery, cents per lb.:

Ingots	35.00	Electrolytic	39.00
Shot			36.00

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00

Base price of Monel metal in cents per lb., f.o.b. Huntington W. Va.:

Shot	32.00	Hot rolled rods (base)	35.00
Blocks	32.00	Cold drawn rods (base)	43.00
Cold rolled sheets (base)	50.00	Hot rolled sheets (base)	42.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	12.25 @12.50	11.50	11.25@11.75
Copper, heavy, and wire	11.50 @12.00	11.75	10.75@11.25
Copper, light, and bottoms	10 00 @10.25	10.00	9.50@10.25
Heavy lead	7 37½@ 7.62½	7.25	7.00@ 7.50
Tea lead	5.50 @ 5.75	5.25	6.00@ 6.50
Brass, heavy, yellow	7 00 @ 7.25	7.50	7.25@ 7.75
Brass, heavy, red	9.50 @ 9.75	9.75	9.00@ 9.50
Brass, light	6.00 @ 6.25	6.50	6.75@ 7.25
No. 1 yellow rod turnings	8.00 @ 8.25	8.25	7.75@ 8.25
Zinc	4.25 @ 4.75	4.50	4.25@ 4.75

TIN PLATES—American Charcoal—Bright—Per box

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$12.10	$11.95	$11.50
"A" Grade:				
IC,	14x20	9.70	9.90	9.50
Coke Plates—Primes—Per box				
100-lb.,	14x20	6.45	6.10	7.00
Terne Plates—Small lots, 8-lb. Coating—Per box				
IC,	14x20	7.75@8.00	6.95	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.13@0.17½	$0.18	$0.15@0.20
Cotton waste, colored, per lb.	.10@ .14	.14	.12@ .17
Wiping cloths, washed white, per lb	.17½	36.00 per M	15
Sal soda, per 100 lb. keg	2.05	2.25	2.75*
Roll sulphur, per 100 lb	2.70†	3.50	4.25‡
Linseed oil, per gal., 5 bbl. lots	.85½	.98	90
Lard cutting oil, 25% lard, per gal.	.55	.50	.48
Machine lubricant, medium-bodied (55 gal. metal bbl.), per gal.	.35	.35	.29
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40–5%	40–5%	40–5%
Heavy grade	30–10%	30–10%	30–10%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50%	50–10%	50%
Second grade	50–10%	60–5%	50–10%

*Per 175 lb. keg. †In 150-lb. bags. ‡Per 425 lb. barrel.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold drawn shafting	per lb.	.04	.04	.0415
Brass rods	per lb.	.1712½	.1712½	.1687½
Solder (½ and ½)	per lb.	.435	.4112½	.395
Cotton waste	per lb.	.13@.17½	.13@.17½	15@22
Washers, cast iron (¼ in.)	per 100 lb.	7.00	7.00	7.00
Emery disks, cloth, No. 1, 6 in. dia.	per 100	3.10	3.10	3.55
Lard cutting oil	per gal.	.55	.55	.55
Machine oil	per gal.	.35	.35	.35
Belting, leather, medium	off list	40–5%	40–5%	40%
Machine bolts, up to 1x30 in.	off list	40%	40%	40%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.40	$5.84	$5.65
Emery paper	10.71	11.00	10.71
Emery cloth	27.84	31.12	29.48
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.32	1.45	1.49
Cloth	3.10	3.50	3.75
Fire clay, per 100 lb. bag		.60	.75
Coke, prompt furnace, Connellsville	per net ton		3.50@ 3.75
Coke, prompt foundry, Connellsville	per net ton		4.25@ 5.00
White lead, dry or in oil	100 lb. kegs	New York, 15.25	
Red lead, dry	100 lb. kegs	New York, 15.25	
Red lead, in oil	100 lb. kegs	New York, 16.75	

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1¼ and 1¼x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%.

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x⅛in., $2.25 per 100, less 40%.

Tap bolts, 1½x½-in., $1.00 per 100. List plus 35% at New York warehouses.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ½x½-in., 2c. each. Discount 70% for ⅜-in and smaller and 65% for ½-in. and larger.
Case hardened ½x½-in., 6c. each, less 50%.

Rivets, button heads, ¾-in., ½-in., 1-in. diam. x2¼-in. to 4½-in $5.00* per 100 lb. at New York warehouses; cone heads, same sizes, $5.20* per 100 lb. Rivets, ⅞x1-in and longer, 19c. per lb., less 50% Same discount for tinned. EXTRA per 100 lb. for 1½ to 2-in. long, all diameters, 25c.; ¾-in. dia., 35c.; ½-in. dia., 75c.; 1-in. long and shorter, 75c.; longer than 5-in., 50c.; less than 200 lb. 50c.; countersunk heads, 45c.

Washers, cast iron, ½-in., $7.00* per 100 lb. at New York warehouses: ¾-in., $6.00* per 100 lb

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Calif., Salinas — Salinas Union High School Dist., E. L. Van Dellen, Clk.—2 lathes for machine shop departments.

Ind., Anderson—Ames Shovel & Tool Co., North Anderson St.—machinery and equipment for forging plant.

Mass., Boston — P. J. McArdle, 93-97 Chelsea St. — miscellaneous tools and equipment for repair and service garage. Estimated cost $60,000.

Mass., Medford—J. A. Gaffey, 19 James St.—blacksmith air drill sharpener.

Mich., Detroit—City, Department Purchase & Supplies, Marquette Bldg.—power driven shear, power driven scrap metal baler.

N. Y., Buffalo—Kushin & Konikoff, 45 Allen St.—lathe, drill press, etc., for proposed repair and service garage. Estimated cost $60,000.

O., Columbus—Bd. Educ. will receive bids until October 11, for milling machine, shaper, grinder, drill press, 4 in. lathe, 5 in. lathe and double forge for McKinley School.

Pa., Norristown—McCarter Iron Works angle shear 4 x 4 x ½ in. angles.

Pa., Pittsburgh—Thomas Co., Fulton Bldg.—plate shear, ¾ to 1 in., 24 in. throat, 8 ft. between housings.

Wis., Madison—C. Reider, 655 University Ave.—small tools and air compressor for proposed 2 story, 60 x 150 ft. service station and shop on Blount St. Estimated cost $43,000.

Wis., Milwaukee—Jambor Tool & Stamping Co., 1261 30th St., H. E. Pressinger, Secy.—punch press.

Wis., Milwaukee—Wisconsin Tool & Mfg. Co., 1219 30th St., H. S. Peterson, Pres.—lathe and 2 drill presses.

Opportunities for Future Business

Calif., Fresno — Syndicate, c/o J. W. Hunt, Cory Bldg., plans the construction of a garage. Estimated cost $150,000.

Ill., Chicago—A. S. Alschuler, 28 East Jackson Blvd., Archt., will soon receive bids for the construction of a 3 story, 100 x 135 ft. addition to factory for Sloan Valve Co., 4300 West Lake St. Estimated cost $100,000.

Ill., Decatur — Wabash Railway Co., Railway Exchange Bldg., St. Louis, Mo., awarded contract for the construction of a 1 story, 50 x 150 ft. addition to reclamation plant here. Estimated cost $50,000. Noted Sept. 2.

Ill., Peoria—Chevrolet Motor Sales Co., 205 Underhill Ave., awarded contract for the construction of 1 story, 80 x 170 ft. automobile service building, on Underhill Ave. Estimated cost $45,000.

Ill., Waukegan—American Can Co., 120 Bway., New York, N. Y., plans the construction of plant on recently purchased site on Sheridan Rd., here.

Ind., Anderson—E. F. Miller, Archt., is receiving bids for the construction of a 1 story, 80 x 200 ft. factory for Ames Shovel & Tool Co., North Anderson St. Estimated cost $40,000.

Ind., Anderson—Remy Electric Co., 25th and Columbus Aves. plans the construction of a 120 x 243 ft. addition, on George St. Estimated cost $40,000. C. M. Gross, c/o owner, Engr.

Ind., Gary—V. Pizarski, 1701 Broadway, awarded contract for the construction of a 2 story, 74 x 120 ft. garage and repair shop. Estimated cost $45,000.

Ind., Lafayette—Ross Gear & Tool Co., Eighth and Heath Sts., is receiving bids for the construction of a 1 story, 55 x 100 ft. factory. Estimated cost $60,000. W. Scholer, Archt.

Ind., Peru—J. Miller is receiving bids for the construction of a 1 story, 45 x 132 ft. machine shop, etc. Estimated cost $40,000. O. F. Cook, Kokomo, Archt.

Mass., Boston—Atlantic Works, 80 Border St., East Boston, awarded contract for the construction of 1 story, 100 x 120 ft. machine shop on Border St.

Mass., Cambridge (Boston P. O.) — F. Hayden, 35 Gorham St., is receiving bids for the construction of 70 x 100 ft. repair and service garage, at 8 Sparks St. Estimated cost $45,000. R. C. Grovestein, 3 Brattle St., Archt. Noted Sept. 17.

Mass., Chelsea (br. Boston)—H. Cloper c/o S. S. Eisenberg, Archt., 46 Cornhill, Boston is receiving bids for the construction of repair and service garage at 62 Bway. Estimated cost $40,000. Former bids rejected.

Mass., Newton—City C. C. Chadwick, Comr. Pub. Bldgs., awarded contract for the construction of a 2 story garage and repair shop on Elliot St. Estimated cost $100,000.

Mass., Quincy (br. Boston)—Matheson Machine Shop, Water St., awarded contract for the construction of 40 x 100 and 20 x 50 ft. machine shop, on Water St.

Mass., South Boston (Br. Boston)—Underwood Machinery Co., 110 Mt. Vernon St. is receiving bids for the construction of 2 story addition to plant and 1 story new building on Mt. Vernon St. Estimated cost $40,000. Private plans.

Mass., Whitman—United Shank & Findigs Co., awarded contract for the construction of a 1 story, 52 x 186 ft. plant. Estimated cost $50,000.

Mich., Detroit — Chrysler Corporation, Highland Park, c/o C. C. Sherk, awarded contract for the design and construction of 1 story, 28 x 220 ft. extension to motor plant, etc. Estimated cost $250,000.

Mich., Muskegon—Vander West & Child, Engrs. and Archts.; Montgomery Blk. will receive bids about October 15, for 2 story, office and 1 story factory for manufacture of irrigation machinery on Bank St., here for March Irrigation Co. Estimated cost $40,000.

Mo., Kansas City—Scarritt Estates, 231 Scarritt Bldg., awarded contract for the construction 4 story, 100 x 127 ft. garage. Estimated cost $150,000. Noted Sept. 23.

Mo., St. Louis—F. H. Fitch, 3800 Baltimore St., Kansas City, plans the construction of 3 story, 100 x 104 ft. garage, at 11th and Morgan Sts. W. R. Bovard, 908 Orear-Leslie Bldg., Archt.

Mo., St. Louis—North Star Realty Co., 1400 South 2nd St., awarded contract for the construction of a 2 story, 50 x 123 ft. sales and service station at 2625 Locust St.

N. Y., New York—Paige-Detroit Co. of New York, 529 West 55th St., S. R. Ball, in charge, plans to build 2 story, 200 x 200 ft. service station, on Fordham Rd. Estimated cost $200,000. Engineer and architect not selected.

O., Akron—National Standard Co., Bettes Corners, awarded contract for the construction of 70 x 260 ft. factory for manufacture of jacks and pumps to Austin Co., 16112 Euclid Ave., Cleveland. Estimated cost $100,000.

O., Cleveland—Forest City Foundry & Manufacturing Co., 1220 Main Ave., P. J. Stangward, Mgr. has had plans prepared for the construction of 60 x 150 ft. foundry on West 94th St. and Maywood Ave. Estimated cost $60,000. P. Schmidt, 4500 Euclid Ave., Archt.

O., Columbus—Bobb-Chevolet Co., 990 Parsons Ave. awarded contract for the construction of 114 x 202 ft. repair garage $65,000.

O., Columbus—Jordan-Columbus Co., 264 North Faunt St., P. M. Ellis, Pres., awarded contract for the construction of 40 x 187 ft. repair garage at 525 East Broad St. $55,000.

O., Jackson—Crown Pipe & Foundry Co. awarded contract for the construction of factory, here. Estimated cost $55,000.

O., Salem—E. H. Althouse will receive bids until Jan. 1 for the construction of a 2 story, 160 x 210 ft. garage on East Pershing Rd. and South Lundry St. Estimated cost $75,000.

Pa., Jeanette—Pittsburgh Engineering Co. is receiving bids for the construction of 110 x 110 ft. foundry and storage plant. Estimated cost $40,000. E. W. Eckert, 420 Y St., Derry, Archt.

Pa., Philadelphia—J. A. Brady, 136 South 4th St. will build 4 story, 97 x 98 ft. garage at 924-928 Race St. Estimated cost $150,000. Noted July 22.

Pa., Philadelphia—J. Cantley, Harrison Bldg., Archt. will soon award contract for the construction of group of buildings, including 2 story, 128 x 160 ft. service building at Pulaski and Chelton Sts. for Davis Buick Co.

Pa., Philadelphia—National Carbon Co., Pier 6, Port Richmond, awarded contract for the construction of 40 x 80 ft. milling plant, at Pier 6, Port Richmond.

Pa., Poland—Shamopin Coal & Coke Co., 311 Ross St., Pittsburgh, is receiving bids for the construction of group of buildings, including 2 story, 43 x 60 ft. shop, 52 x 151 ft. blacksmith shop, etc. here. Estimated cost $100,000. G. S. Baton Co., 1 Natl. Bank Bldg.; Pittsburgh, Engr.

Pa., Shire Oaks (Elrama P. O.)—Pennsylvania R.R. Co., Broad St. Station, Philadelphia, is having plans prepared for the construction of 78 x 118 ft. engine house, 60 x 100 ft. storehouse, 46 x 48 ft. oil house, machine shop alterations, etc. Estimated cost $500,000. A. C. Shand, Broad St. Station, Phila. Ch. Engr.

Tenn., Memphis—National Garages, Inc., c/o F. Callahan, Pres. U & P Bank Bldg., awarded contract for the construction of a 9 story, 100 x 150 ft. garage, at North Front and Court Sts. Estimated cost $800,000.

Wis., La Crosse—Motometer Co., Caledonia and Gillett Sts. awarded contract for the construction of 82 x 140 ft. factory addition, here to F. R. Schwalbe & Sons, 414 Rivioli Bldg. Estimated cost $40,000.

Wis., Milwaukee—White Co., 842 East 79th St., Cleveland, O., is receiving bids for the construction of a 1 story, 170 x 200 ft. garage and service station on Clybourn St. H. R. Hadlow, c/o owner, Archt.

Wis., Mount Horeb — J. C. Hanley, awarded contract for the construction of 50 x 92 ft. service station and shop building.

Alta., Edmonton—Maple Leaf Mills, Ltd., will soon receive bids for the construction of steel mills. Estimated cost $300,000.

Ont., Hamilton — Dominion Power & Transmission Co. plans the construction of car barns and repair shop. Estimated cost $200,000. G. E. Waller, c/o owner, Engr.

Ont., Windsor — Michigan Central R.R. Co., Passenger Terminal Station, Detroit, Mich., plans extensive improvements to engine shops, here. Estimated cost $200,000. J. F. Deimling, Ch. Engr.